



United States Department of the Interior

Fish and Wildlife Service



Bloomington Field Office (ES)
620 South Walker Street
Bloomington, IN 47403-2121
Phone: (812) 334-4261 Fax: (812) 334-4273

3 December 2003

Kathleen H. Quinn
Acting Division Administrator, Indiana Division
U.S. Department of Transportation
Federal Highway Administration
575 North Pennsylvania Street, Room 254
Indianapolis, IN 46204

Dear Ms. Quinn:

The enclosed document transmits the U.S. Fish and Wildlife Service's (Service) Biological Opinion regarding the proposed construction, operation, and maintenance of Alternative 3C of Interstate 69 (I-69) from Indianapolis to Evansville, Indiana and its effects on the Federally endangered Indiana bat (*Myotis sodalis*) and the Federally threatened bald eagle (*Haliaeetus leucocephalus*). Alternative 3C traverses portions of Gibson, Warrick, Pike, Daviess, Greene, Monroe, Morgan, Johnson, and Marion counties in Indiana.

The Biological Opinion was based on information provided from the following sources: 1) the Tier 1 Biological Assessment for Threatened and Endangered Species, Interstate 69, Indianapolis to Evansville [dated July 18, 2003, revised October 27, 2003; submitted by Federal Highway Administration (FHWA) and the Indiana Department of Transportation (INDOT), prepared by Bernardin, Lochmueller and Associates, Inc.(BLA)], 2) the I-69, Evansville to Indianapolis, Indiana, Tier 1 Draft Environmental Impact Statement (prepared by FHWA and INDOT, dated July 22, 2002), 3) reports and scientific literature on Indiana bat and bald eagle research conducted in the action area and elsewhere, and 4) meetings, phone calls, and written correspondence with FHWA, INDOT, and their consultants. Brief field investigations were also conducted by Service personnel from the Bloomington, Indiana Field Office (BFO). This Biological Opinion considers the broad impacts of the entire action (50 CFR §402.14(k)) and was prepared in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.).

To ensure that the impacts of take associated with the final alignments chosen for each of the six forthcoming Tier 2 Project Sections of I-69 are appropriately minimized and that the exemption of incidental take is appropriately tracked and documented, the FHWA and the Service will implement an appended programmatic consultation approach for this project. Under this approach, the Service's programmatic Biological Opinion and Incidental Take Statement for I-69

have considered and quantified reasonable amounts of anticipated incidental take for Indiana bats and bald eagles for the entire I-69 project from Evansville to Indianapolis during Tier 1. All impacts associated with a Tier 2 Project Section will be analyzed in a Tier 2 Biological Assessment and individually reviewed by the Service to determine if the effects are consistent with those analyzed in the programmatic Biological Opinion and addressed by the Incidental Take Statement's reasonable and prudent measures and associated terms and conditions. This approach will ensure that once specific alignments are identified, that the site-specific impacts of the resulting incidental take are minimized. If an individual Tier 2 Project Section is found to be consistent with the programmatic consultation it will be appended to the programmatic Biological Opinion and Incidental Take Statement, along with any project section-specific reasonable and prudent measures and terms and conditions that the Service believes are needed to fulfill the requirements of section 7(a)(2). Details on how specific impacts associated with each Tier 2 Project Section will be reported and documented are included in the enclosed Incidental Take Statement.

If you have any questions about the biological opinion/incidental take statement or how Tier 2 consultations should proceed, please contact Andy King at 812-334-4261, extension 216.

Sincerely yours,

A handwritten signature in black ink, appearing to read "Scott E. Pruitt", with a stylized flourish at the end.

Scott E. Pruitt
Field Supervisor

cc: Robert E. Dirks, FHWA
Lyle Sadler, INDOT
Michael Grovak, BLA, Inc.
Catherine Gremillion-Smith, IDNR

enclosure

BIOLOGICAL OPINION

on the

CONSTRUCTION, OPERATION, AND MAINTENANCE OF ALTERNATIVE 3C OF INTERSTATE 69 (I-69) FROM INDIANAPOLIS TO EVANSVILLE

FOR THE FEDERALLY ENDANGERED INDIANA BAT (*Myotis sodalis*) AND THE FEDERALLY THREATENED BALD EAGLE (*Haliaeetus leucocephalus*)

traversing portions of

**GIBSON, WARRICK, PIKE, DAVIESS, GREENE, MONROE, MORGAN,
JOHNSON, AND MARION COUNTIES, INDIANA**

**Submitted to the Federal Highway Administration
December 3, 2003**

Prepared by:
R. Andrew King
U.S. Fish and Wildlife Service
Bloomington Field Office
620 S. Walker Street
Bloomington, IN 47403
(812) 334-4261

TABLE OF CONTENTS

INTRODUCTION.....	1
CONSULTATION HISTORY	1
BIOLOGICAL OPINION	5
I. DESCRIPTION OF THE PROPOSED ACTION.....	5
The FHWA's Tiered Approach.....	8
Tier 1 Forest and Wetland Mitigation and Enhancement Plan	8
Conservation Measures	10
Action Areas	20
The Service's Section 7 Consultation Approach.....	22
II. STATUS OF THE SPECIES	24
Indiana Bat.....	24
Bald Eagle.....	33
Fanshell Mussel.....	37
III. ENVIRONMENTAL BASELINE.....	38
Physiographic Regions	38
Natural Regions.....	40
Major Drainages.....	45
Karst Features	46
General Habitat Conditions	47
Indiana Bats in the Action Area.....	47
Bald Eagles in the Action Area.....	54
IV. EFFECTS OF THE ACTION.....	55
Indiana Bat.....	56
Bald Eagle.....	69
V. CUMULATIVE EFFECTS	72
Cumulative Effects within the Indiana Bat Action Areas.....	72
Cumulative Effects within the Bald Eagle Action Area	74
VI. CONCLUSION.....	75
INCIDENTAL TAKE STATEMENT	76
INDIANA BAT.....	76
AMOUNT OR EXTENT OF TAKE	76
EFFECT OF THE TAKE	78
REASONABLE AND PRUDENT MEASURES	78
TERMS AND CONDITIONS	79

BALD EAGLE.....	81
AMOUNT OR EXTENT OF TAKE	81
EFFECT OF THE TAKE	81
REASONABLE AND PRUDENT MEASURES	81
TERMS AND CONDITIONS	82
CONSERVATION RECOMMENDATIONS	84
REINITIATION NOTICE.....	85
LITERATURE CITED.....	86

INTRODUCTION

This document transmits the U.S. Fish and Wildlife Service's (Service or USFWS) biological opinion based on our review of the Tier 1 Biological Assessment for Threatened and Endangered Species, Interstate 69, Indianapolis to Evansville (dated July 18, 2003, revised October 27, 2003) (hereafter referred to as the Tier 1 BA). The Tier 1 BA was submitted by The Federal Highway Administration (FHWA) and was received at the Service's Bloomington, Indiana Field Office (BFO) on July 21, 2003 along with a letter requesting us to initiate formal consultation on the proposed construction, operation, and maintenance of Alternative 3C of Interstate 69 (I-69) from Indianapolis to Evansville, Indiana and its effects on the Federally endangered Indiana bat (*Myotis sodalis*) and the Federally threatened bald eagle (*Haliaeetus leucocephalus*).

This biological opinion is prepared in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.). This biological opinion is the culmination of formal section 7 consultation under the Act. The purpose of formal section 7 consultation is to insure that any action authorized, funded, or carried out by the Federal government is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat of such species. This biological opinion covers the actions of the FHWA, as this agency will fund, in part, the road construction associated with this project.

Road construction that will occur as part of the proposed project will require a permit(s) from the U.S. Army Corps of Engineers (COE). However, the COE permits will not result in any impacts to Indiana bats or bald eagles beyond those addressed in this consultation with the FHWA. The Service will provide a copy of this biological opinion to the COE to demonstrate that the FHWA has fulfilled its obligations to consult with the Service.

This biological opinion is based on information provided from the following sources: 1) the BA entitled Tier 1 Biological Assessment for Threatened and Endangered Species, Interstate 69, Indianapolis to Evansville [dated July 18, 2003, revised October 27, 2003; submitted by FHWA and the Indiana Department of Transportation (INDOT), prepared by Bernardin-Lochmueller and Associates, Inc.(BLA)], 2) the I-69, Evansville to Indianapolis, Indiana, Tier 1 Draft Environmental Impact Statement (prepared by FHWA and INDOT, dated July 22, 2002), 3) reports and scientific literature on Indiana bat and bald eagle research conducted in the action area and elsewhere, and 4) meetings, phone calls, and written correspondence with FHWA, INDOT, and their consultants. A few brief field investigations were also conducted by Service personnel from the Bloomington, Indiana Field Office (BFO). A complete administrative record of this consultation is on file at BFO.

CONSULTATION HISTORY

The proposed action has a background that encompasses several decades of planning and planning studies by INDOT and is outlined in Chapter 1 of the Tier 1 DEIS. Studies since 1990 have been focused on the currently proposed project area. The 1996 DEIS for the Southwest Indiana Highway Project follows the currently proposed 3C alignment very closely.

In 1989-90, the Southwest Indiana Highway Feasibility Study (Indianapolis to Evansville, Rockport, or Tell City) (Donohue study) addressed three feasible north-south routes, all of which used SR 37 from Bloomington to Indianapolis. That study found Alternative A, from Evansville to Indianapolis, economically feasible based on optimistic assumptions for business attraction.

An environmental study for the Indianapolis to Evansville Highway was done in 1990. This study was based on Alternative A from the 1989-90 feasibility study. The corridor was separated into three sections and did not consider upgrading SR 37 to an Interstate. Section 1 (Bloomington to Newberry) was developed as an EIS, while section 2 (Newberry to Petersburg) and section 3 (Petersburg to Evansville) were developed as preliminary overviews for detailed studies to come later. In 1992, the decision was made to consolidate all three sections of the 1990 study into a single DEIS between Evansville and Bloomington.

The DEIS for the Southwestern Indiana Highway Project (Evansville to Bloomington) was published in 1996. The preferred route studied in the 1996 DEIS closely followed what is currently being proposed as Alternative 3C or the preferred alternative for proposed I-69. For the 1996 study, karst features were investigated, forest plots were surveyed, and wetlands were delineated, in addition to other standard NEPA elements. That document included extensive fish, wildlife, and plant field surveys; and literature review. Those pertinent to this consultation are summarized as follows:

MAMMALS: During the summer of 1993, small mammal surveys were conducted including mist netting for bats at 21 sites between I-64 and Bloomington. Mist nest surveys resulted in the capture of 65 bats of seven species including two lactating female Indiana bats that were captured in the Patoka River Bottoms (Whitaker 1996).

BIRDS: Surveys of birds were conducted at 19 sites in the Wabash Lowland region, nine sites in the Crawford Upland region, and two sites in the Mitchell Plain region. A total of 30 sites were observed for birds in July and September 1993. The survey found 101 species from 34 families. Species richness was highest in the Patoka River Bottoms, but no bald eagles or other Federally listed birds were observed within the study area.

MUSSELS: Mussels were surveyed by handpicking at 28 locations in the Wabash Lowland regions, 6 locations in the Crawford Upland region, and 3 locations in the Mitchell Plain Region. Proposed river crossings were sampled using a crowfoot bar. Surveys found 68 individuals of 12 species of mussels, 9 species of relict shells, and 3 species with live shells. No Federally listed mussels were found.

In 1998, INDOT decided to expand the scope of the EIS for the Southwest Indiana Highway Project to include consideration of the need for an Evansville-to-Indianapolis link in the context of the planned extension of I-69. With the major change in scope, new corridor alternatives were evaluated. The result of this expanded study culminated in FHWA and INDOT initiating a two-tiered NEPA process and the release of the Tier 1 DEIS for proposed I-69 in July 2002 and the subsequent July 2003 submittal of a Tier 1 Biological Assessment with FHWA's request to initiate formal section 7 consultation on Alternative 3C, INDOT's preferred alternative. A

chronological summary of important consultation events and actions associated with this project is presented in Table 1.

Table 1. Summary of NEPA and section 7 consultation history for the currently proposed action.

Date	Event / Action
February 3, 2000	INDOT and FHWA hosted a "Scoping Meeting" with environmental review agencies.
June 5, 2001	INDOT and FHWA convened an agency review meeting to discuss the "Purpose and Need Statement" (including a comparison of Tier 1 & 2 EIS)
November 27, 2001	INDOT and FHWA convened an agency review meeting to discuss their "Screening of Alternatives" for I-69 (included environmental information).
December 21, 2001	BFO sent a letter to BLA with comments on the Draft Level 2 Alternatives Analysis Report for the Evansville to Indianapolis I-69 study including endangered species and critical habitat technical information.
March 14, 2002	Federally listed species were reviewed and appropriate tables constructed with species, their number and status and presented to the USFWS at the BFO.
June 4 and 5, 2002	A BFO biologist took a two-day bus tour of I-69 alternatives focused on environmentally sensitive areas with INDOT, FHWA, USEPA, IDNR, and BLA representatives.
June 2002	Through informal consultation with the Service INDOT agreed to shift the common alignment of Alternative 3A, B, and C to be beyond the range of bats that forage around and hibernate in Ray's Cave, which is Designated Critical Habitat for the Indiana bat in Greene County
June 27, 2002	FHWA sent a letter to BFO requesting a list of Federally listed species and Designated Critical Habitat that may be present in the I-69 study area of 5 alternatives being carried forward for detailed analysis in the DEIS.
July 1, 2002	BFO sent FHWA a species list for all 5 alternatives that included 6 species and one cave Designated Critical Habitat for the Indiana bat that may be present within the proposed project counties.
July 22, 2002	INDOT and FHWA released their Tier 1 DEIS for public comment
November 14, 2002	BFO commented on the Tier 1 DEIS are combined with those of the National Park Service and sent in single letter from the Department of the Interior's Washington Office to FHWA.
January 9, 2003	Governor Frank O'Bannon announced Alternative 3C as INDOT's recommendation as the "preferred alternative" for I-69.
February 21, 2003	FHWA requests a species list for their preferred alternative, 3C.
February 28, 2003	FHWA sends BFO a letter requesting comments on regarding the four variations of Alt. 3C around the City of Washington.

March 11, 2003	An Agency Coordination Meeting was held at BFO to discuss a Conceptual Tier 1 Forest and Wetland Mitigation Plan, Sections of Independent Utility, the proposed Patoka River crossing, and how the sec. 7 consultation would coincide with Final EIS preparation.
March 13, 2003	BFO sent FHWA a letter listing 3 species that may be present in the Alternative 3C study area, Indiana bat, bald eagle, and fanshell mussel.
March 14, 2003	BFO sent FHWA a letter advising them to choose one of the two eastern routes around Washington (variation "WE1" was specifically recommended) as they were less likely to have adverse affects to Indiana bats or bald eagles because impacts to forest and wetlands would be smaller.
March 26, 2003	BLA sent BFO a Draft BA addressing effects to Alt. 3C on Indiana bats, bald eagles, and fanshell mussels and requested our review and comments.
May 30, 2003	BFO returned comments on Draft BA to BLA.
June 15 - July 2003	BFO assisted INDOT and BLA in developing Conservation Measures to be included in the BA that would avoid and minimize incidental take of Indiana bats and bald eagles.
July 21, 2003	BFO received a revised BA and letter from FHWA requesting formal section 7 consultation for the effects of Alt. 3C of I-69 on Indiana bats and bald eagles. The letter also requested our concurrence that fanshell mussels were not likely to be adversely affected by Alt. 3C. (the 135-day formal consultation timeframe began).
August 22, 2003	BFO sent FHWA a letter acknowledging receipt and completeness of formal consultation initiation package. Informed FHWA that the Service expected to provide them with a final Biological Opinion no later than December 3, 2003. Based on information contained in the BA, the Service also provided the FHWA our written concurrence with their determination that the fanshell mussel was "not likely to be adversely affected" by the proposed construction, operation, and maintenance of Alternative 3C of I-69.
August - November 2003	BFO consulted with FHWA/INDOT/BLA to gain clarification on various issues resulting in several revisions to the Tier 1 BA.
November 28, 2003	BFO sent FHWA/INDOT/BLA a draft Biological Opinion for review.
December 2, 2003	FHWA/INDOT/BLA returned comments on draft BO to BFO.
December 3, 2003	BFO sent FHWA/INDOT/BLA the Final Biological Opinion for Alternative 3C of I-69.

BIOLOGICAL OPINION

I. DESCRIPTION OF THE PROPOSED ACTION

With the aid of FHWA funds, the INDOT is proposing to construct, operate, and maintain a new interstate highway, approximately 140 miles in length connecting the cities of Evansville and Indianapolis, via Oakland City, Washington, the Crane Naval Surface Warfare Center, Bloomington, and Martinsville, Indiana. Approximately 35% of the proposed route would be mostly within the footprint of an existing 4-lane highway, State Route 37; however, the remaining 65% or approximately 90 miles of interstate would be constructed over new-terrain. The proposed action would also involve constructing approximately 24 new interchanges, but the actual number may change in Tier 2, and an unknown amount of new frontage roads. The project is part of a larger, national proposal to connect the three North American trading partners of Canada, the United States, and Mexico by an interstate highway in the states of Michigan, Indiana, Kentucky, Tennessee, Mississippi, Arkansas, Louisiana, and Texas. The purpose of the proposed I-69 Evansville to Indianapolis Project is to provide an improved transportation link between Evansville and Indianapolis that: 1) strengthens the transportation network in southwestern Indiana, 2) supports economic development in southwestern Indiana, and 3) completes the portion of the national I-69 project between Evansville and Indianapolis.

In January 2003, then Indiana governor Frank O'Bannon announced a preferred alternative from 14 alternatives that had been put forward for detailed study in the Tier 1 DEIS approved on July 22, 2002. The preferred alternative is known as Alternative 3C in the Tier 1 DEIS. The working alignment for Alternative 3C is near SR 57 from Evansville to Washington, crossing the purchase boundary of the Patoka River National Wildlife Refuge. The alternative continues overland east around Washington to Elnora then turns east to Bloomington. From Bloomington, the alternative follows existing state highway 37 to connect to I-465 at Indianapolis (Figure 1). While the Tier 1 DEIS analyzed 14 alternatives, the Tier 1 BA only addressed anticipated impacts of the preferred alternative, Alternative 3C.

Tier 2 Project Sections

The six project sections to be carried forward to Tier 2 are (traveling northeast) (Figure 2):

1. From I-64 (near Evansville) via the SR 57 corridor to SR 64 (near Princeton/Oakland City)
2. From SR 64 (near Princeton/Oakland City) via the SR 57 corridor to US 50 (near Washington)
3. From US 50 (near Washington) via the SR 57 corridor and cross country to US 231 (near Crane Naval Surface Warfare Center (NSWC))
4. From US 231 (near Crane NSWC) via cross country to SR 37 (south of Bloomington)
5. From SR 37 (south of Bloomington) via SR 37 to SR 39 (Martinsville)
6. From SR 39 (Martinsville) via SR 37 to I-465 (Indianapolis)

The width of the typical interstate sections differ depending on three factors: 1) flat versus hilly topography (broadly determined by physiographic region), 2) number of traffic lanes needed, and 3) number, if any, of frontage roads needed.

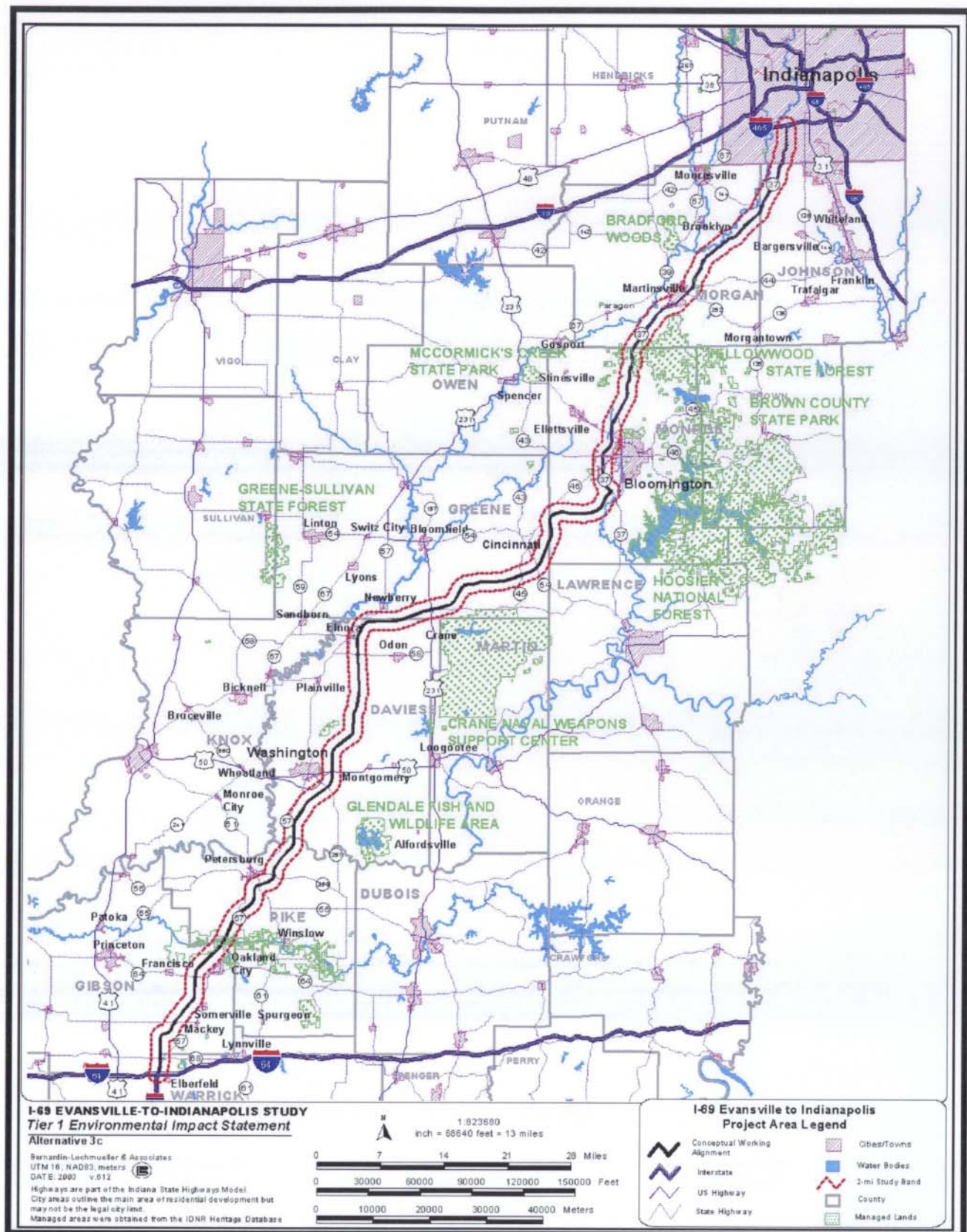


Figure 1. Proposed I-69 Alternative 3C (Preferred Alternative).

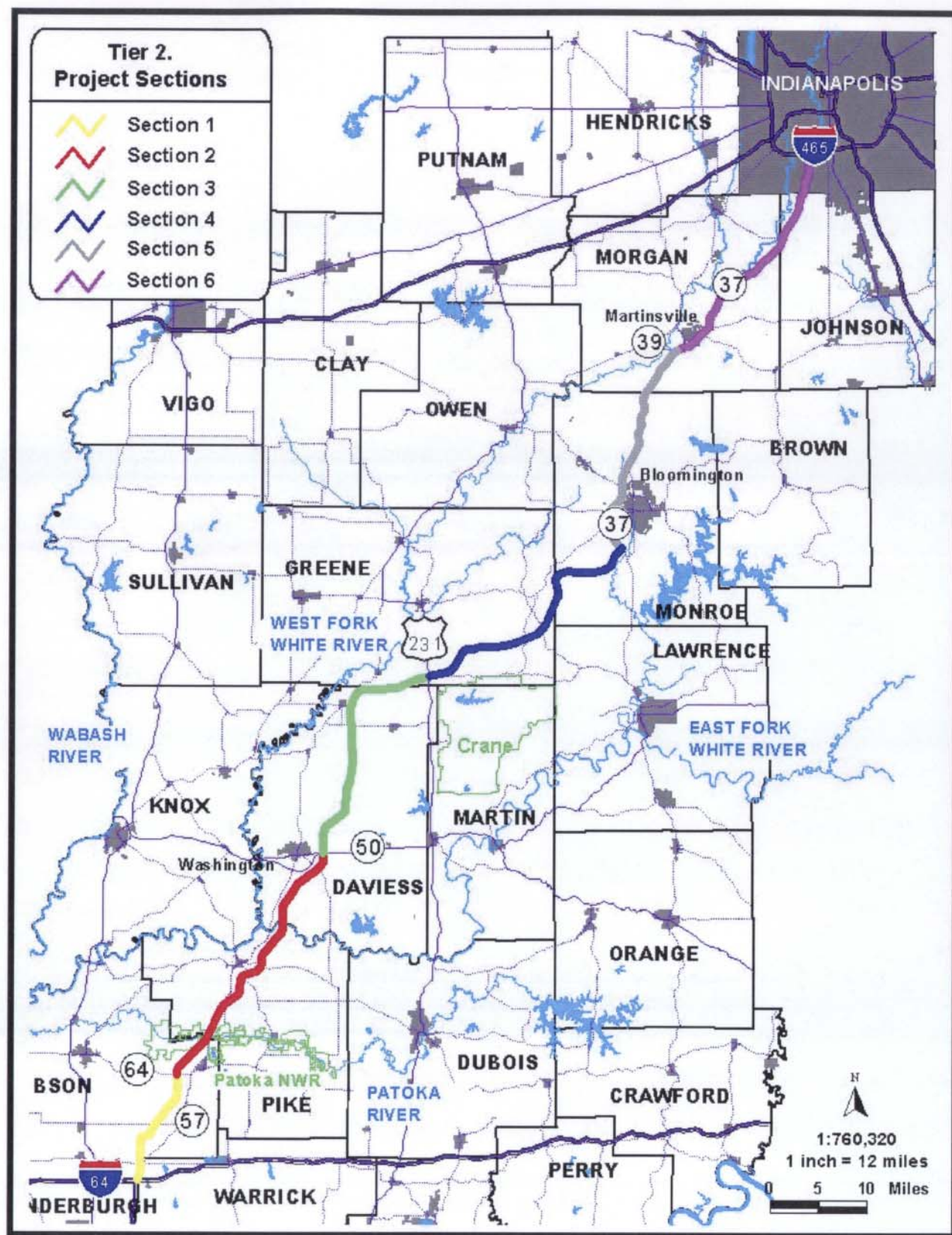


Figure 2. Projects Sections for Tier 2.

The FHWA's Tiered Approach

The FHWA's National Environmental Policy Act (NEPA) studies for proposed I-69 from Evansville to Indianapolis, Indiana are being completed in two tiers. The Council on Environmental Quality (CEQ) guidelines and Federal Highway Administration (FHWA) guidelines allow NEPA studies for large, complex projects to be completed in a two-staged or "tiered" process. Tier 1 of the study involves extensive environmental, transportation, and economic studies, and cost analyses. The final Tier 1 NEPA document will be an Environmental Impact Statement (EIS) that provides a basis for the FHWA to grant approval for a specific corridor (presumably Alternative 3C). In most cases, the proposed corridor is approximately 2000 feet wide, but has been narrowed in some instances to avoid sensitive environmental areas. A working alignment within the corridor, ranging from approximately 270 to 470 feet wide, was developed to estimate the potential impacts analyzed in the Tier 1 BA. It is important to note that specific alignment decisions within a project section will not be finalized until after the Tier 2 study processes and consultations have been completed for each project section.

Tier 2 NEPA studies will be conducted to determine a specific alignment within the selected corridor. The corridor selected in Tier 1 will be divided into six "project sections" in Tier 2. To provide more flexibility, detailed Tier 2 NEPA studies will be conducted on each project section rather than singly on the entire route. Each Tier 2 study will look beyond its project termini to determine if there is anything sensitive just beyond the termini that would affect the location of the adjoining project. This will provide additional assurance that decisions made in one section do not prematurely preclude consideration of alternatives within the preferred corridor for adjoining sections. In general, the range of alternatives in Tier 2 will be confined to the corridor selected in Tier 1. However, flexibility exists to consider alternatives outside the corridor, with consultation, if necessary to avoid unanticipated impacts.

Tier 1 Forest and Wetland Mitigation and Enhancement Plan

As part of the proposed action, INDOT and FHWA developed a Tier 1 Forest and Wetland Mitigation and Enhancement Plan for the proposed project in consultation with the Service and other review agencies. This plan describes 17 potential sites where wetland and forest restoration and conservation efforts would be targeted. These sites are "conceptual" in nature, and are general areas rather than specific parcels of land. The Plan is intended to provide a list of potential mitigation sites. The actual mitigation sites to be implemented for the project will be determined in Tier 2, in consultation with the Service, and could include different sites than those identified in the Plan.

Mitigation for wetlands will be replaced in the same watershed and at ratios described in INDOT's Wetland Memorandum of Understanding (MOU) dated January 21, 1991. INDOT has committed to mitigate losses to upland forest at a 3:1 ratio by purchasing existing habitat and/or creating, restoring, and enhancing habitat. Mitigation sites in upland forested areas will be incorporated with wetland areas and other forested areas when feasible in an effort to expand existing core forest habitat and otherwise augment existing ecological communities. Potential mitigation sites also were specifically targeted to create/enhance habitat for Federal and state threatened, endangered, and rare species. For example, potential sites near large, open water bodies were targeted as appropriate habitat for bald eagles. Likewise some forested areas near known Indiana bat hibernacula were targeted because they provide suitable foraging and roosting

habitat for the bats. Detailed information pertaining to each potential mitigation site is provided in the Tier 1 Forest and Wetland Mitigation and Enhancement Plan and is hereby incorporated by reference.

Potential sites were also developed with one or more of the following themes in mind: 1) **Restoration/Replacement**, 2) **Conservation/Preservation**, and 3) **Education/Research**. Most sites would incorporate more than one theme. The Restoration/Replacement theme involves replacement and/or restoration of wetlands and forest impacted at various ratios, depending upon the type of resource. Wetlands will be mitigated at or above the ratios outlined in the Wetland MOU, and upland forest will be mitigated at a 3:1 ratio. The Conservation/Preservation theme includes purchasing properties, or development rights, that provide protection or enhancement of an existing natural resource such as: Indiana bat hibernacula, bald eagle habitat, caves, springs, barrens, prairie remnants, and old growth forest. Properties will only be purchased from willing sellers, and will be donated to appropriate governmental agencies and possibly registered in a land management classification for protection in perpetuity. Installation of bat-friendly cave gates, as appropriate, also may be considered under this theme as well as constructing bridges that completely span some major river floodplains to protect existing wetlands, wildlife corridors, and hydrology. The Education/Research theme includes educating government leaders and the public on environmental stewardship and Indiana's historical heritage. This theme will include 1) context-sensitive solutions, such as planting native wildflowers, grasses, and trees along the right-of-way, variable-width median, encourage enhancement of borrow pits for wildlife habitat and aesthetics, education at rest stops about environmental issues, 2) construction of an interchange to provide access to a future visitor's center at the Patoka River National Wildlife Refuge, 3) grants-in-aid funding made available for environmental monitoring and research, and 4) development and free distribution of GIS-based environmental data to the public to facilitate environmental planning efforts on a local, county, and regional basis.

The Tier 1 Forest and Wetlands Mitigation and Enhancement Plan identifies a total of 220 acres of jurisdictional wetlands as potential mitigation sites for the potential loss of 65 acres of forested wetlands, 5 acres of impacted scrub/shrub wetlands, and 5 acres emergent wetlands. The proposed wetlands mitigation acreage is based on a commitment to replace wetlands at a ratio of 3:1 for forested and scrub/shrub wetlands, and a ratio of 2:1 for emergent wetlands. In addition to wetland mitigation, the Tier 1 Forest and Wetlands Mitigation and Enhancement Plan identifies a total of 3,186 acres of forested lands as potential mitigation sites for an estimated 1,062 acres of impacts to upland/bottomland forest. The proposed forest mitigation is based on a commitment to mitigate for upland forests at a ratio of 3:1. In addition to these amounts, a buffer for each wetland mitigation site has also been included within the Plan totaling 55 acres.

The mitigation ratios stated in the Plan reflect the minimum mitigation for upland forest and wetlands proposed in Tier 1. The actual number of acres of forest and wetlands mitigation implemented under the Plan will depend on the actual impacts as determined during Tier 2; if impacts are reduced below the levels estimated in Tier 1, then the level of mitigation acreage required under the Plan will be reduced accordingly; if the impacts are higher than estimated in Tier 1, then the mitigation acreage would increase. Further enhancements to the mitigation measures listed in the Plan will be determined in consultation with the Service and other regulatory agencies on a case-by-case basis in Tier 2. Wetland impacts will be mitigated within

Table 2. Habitat types, estimated impacts, mitigation ratios, and proposed amounts of mitigation within/near the listed species action areas for I-69 Alternative 3C variable-width, working-alignment, as identified from NWI maps.

Habitat Type	Estimated Impact (acres)	Mitigation Ratio	Minimum Mitigation Offered	Proposed Mitigation (acres)
Forested Wetlands	65	3:1	198	214
Scrub / Shrub Wetlands	5	3:1	15	20
Emergent Wetlands	5	2:1	6	10
Wetland Buffer/Prairies	---	---	55	72
Upland/Bottomland Forests*	1,062	3:1	3,186	3,773
Total	1,137	----	3,461	4,089

Table 3. Additional mitigation sites located outside the listed species action areas for karst and upland forest habitat.

Habitat Type	Conservation Acres Available
Karst / Forest Habitat in Lost River Area in Orange County	1,100 (60% forest, 40% pasture)
Old Growth Forest near Pioneer Mothers	80 (100% forest)
Total	1,180 (approx. 740 ac. of forest)

their same 8-digit watersheds. Table 2 summarizes the types, estimated impacts, mitigation ratios, and proposed mitigation located within/near the listed species action areas for the I-69 Alternative 3C alignment. Table 3 shows two additional proposed mitigation sites located outside the action areas for karst and upland forest habitat.

Conservation Measures

The following conservation measures were jointly developed by the FHWA, INDOT, and the Service during informal consultation and were subsequently incorporated into the Tier 1 BA as part of the proposed action. These measures were specifically designed to avoid and minimize impacts of the proposed action on Indiana bats and bald eagles and to further their recovery. The Service has analyzed the effects of the proposed action based on the assumption that all conservation measures will be implemented or equivalent measures developed in consultation with the Service during Tier 2. The beneficial effects of the following measures were taken into consideration for both jeopardy and incidental take analyses.

INDIANA BAT (*Myotis sodalis*)

A. CONTEXT SENSITIVE SOLUTIONS

WINTER HABITAT

- Alignment Planning** - Efforts will be made to locate Interstate alignments beyond 0.5 miles from known Indiana bat hibernacula.
- Blasting** - Blasting of rock during construction of the Interstate will be avoided in winter between September 15 and April 15 in areas near hibernacula.

USFWS and experts will be involved in coordination to determine acceptable blasting distance limits. All blasting will follow the specifications in the Tier 2 EIS and will be conducted in a manner that will not compromise the structural integrity or alter the karst hydrology of nearby caves serving as Indiana bat hibernacula.

3. **Hibernacula Surveys** – A plan for hibernacula surveys (caves and/or mines) will be developed and conducted in consultation with and approved by USFWS during Tier II studies.
4. **Karst Hydrology** – To avoid and minimize the potential for flooding, dewatering, and/or microclimate (i.e., temperature and humidity) changes within hibernacula, site-specific efforts will be made to minimize changes in the amount, frequency, and rate of flow of roadway drainage that enters karst systems that are determined to be hydrologically connected to Indiana bat hibernacula.

AUTUMN/SPRING HABITAT

5. **Tree Removal** – To minimize adverse effects on bat habitat, tree (3 or more inches in diameter) cutting will be avoided within 5 miles of a known hibernaculum. If unavoidable, cutting will only occur between November 15 and March 31.

SUMMER HABITAT

6. **Alignment Planning** - Efforts will be made to locate Interstate alignments so they avoid transecting forested areas and fragmenting core forest where reasonable.
7. **Tree Removal** - Tree and snag removal will be avoided or minimized as follows:
 - a. **Tree Cutting** - To avoid any direct take of Indiana bats, no trees with a diameter of 3 or more inches will be removed between 15 April and 15 September. Tree clearing and snag removal will be kept to a minimum and limited to within the construction limits. In the median, tree clearing will be kept to a minimum with woods kept in as much a natural state as reasonable. Forested medians will be managed following IDNR State Forest timber management plan.
 - b. **Mist Netting** - In areas with suitable summer habitat for the Indiana bat, mist net surveys will be conducted between 15 May and 15 August at locations determined in consultation with the USFWS as part of Tier 2 studies. If Indiana bats are captured, some will be fitted with radio

transmitters and tracked to their diurnal roosts for at least 5 days unless otherwise determined by USFWS.

8. Bridges – Bridges will include the following design features:

- a. **Surveys** – The undersides of existing bridges that must be removed for construction of I-69 will be visually surveyed and/or netted to determine their use as night roosts by Indiana bats during the summer.
- b. **Bat-friendly bridges** – Where feasible and appropriate, Interstate and frontage road bridges will be designed to provide suitable night roosts for Indiana bats and other bat species in consultation with the USFWS.
- c. **Floodplains** – Where reasonable and appropriate, floodplains and oxbows will be bridged to protect environmentally sensitive areas. The Patoka River floodplain will be bridged in its entirety, thus minimizing impacts to many different habitats.

9. Stream Relocations – Site-specific plans for stream relocations will be developed in design considering the needs of sensitive species and environmental concerns. Plans will include the planting of woody and herbaceous vegetation to stabilize the banks. Such plantings will provide foraging cover for many species. Stream Mitigation and Monitoring plans will be developed for stream relocations, as appropriate.

ALL HABITATS

- 10. Medians and Alignments** – Variable-width medians and Independent Alignments will be used where appropriate to minimize impacts to sensitive and/or significant habitats. Context sensitive solutions will be used, where possible. This may involve vertical and horizontal shifts in the Interstate.
- 11. Minimize Interchanges** - Efforts have been made to limit interchanges in karst areas, thereby limiting access and discouraging secondary growth and impacts. In Tier 2, further consideration will be given to limiting the location and number of interchanges in karst areas.
- 12. Memoranda of Understandings (MOUs)** - Construction will adhere to the Wetland MOU (dated January 28, 1991) and Karst MOU (dated October 13, 1993). The Wetland MOU minimizes impacts to the Indiana bat by mitigating for wetland losses; and creating bat foraging areas at greater ratios than that lost to the project. The Karst MOU avoids and minimizes impacts to the Indiana bat by numerous measures which protect sensitive karst features including hibernacula.
- 13. Water Quality** - Water contamination will be avoided/minimized by the following:

- a. **Equipment Service** - Equipment servicing and maintenance areas will be designated to areas away from streambeds, sinkholes, or areas draining into sinkholes.
 - b. **Roadside Drainage** - Where appropriate in karst areas, roadside ditches will be constructed that are grass-lined and connected to filter strips and containment basins.
 - c. **Equipment Maintenance** - Construction equipment will be maintained in proper mechanical condition.
 - d. **Spill Prevention/Containment** – The design for the roadway will include appropriate measures for spill prevention/containment.
 - e. **Herbicide Use Plan** - The use of herbicides will be minimized in environmentally sensitive areas, such as karst areas that are protective of Indiana bats and their prey.
 - f. **Revegetation** - Revegetation of disturbed areas will occur in accordance with INDOT standard specifications. Woody vegetation will only be utilized beyond the clear zone. Revegetation of disturbed soils in the right-of-way and medians will utilize native grasses and wildflowers, as appropriate, similar to the native seed mixes of other nearby states.
 - g. **Low Salt Zones** – A low salt and no spray strategy will be developed in karst areas for this project. A signing strategy for these items will also be developed.
 - h. **Bridge Design** – Where feasible and appropriate, bridges will be designed with none or a minimum number of in-span drains. To the extent possible, the water flow will be directed towards the ends of the bridge and to the riprap drainage turnouts.
14. **Erosion Control** - Temporary erosion control devices will be used to minimize sediment and debris. Timely revegetation after soil disturbance will be implemented and monitored. Revegetation will consider site specific needs for water and karst. Erosion control measures will be put in place as a first step in construction and maintained throughout construction.
15. **Parking and Turning Areas** – Parking and turning areas for heavy equipment will be confined to sites that will minimize soil erosion and tree clearing, and will avoid environmentally sensitive areas, such as karst.

B. RESTORATION / REPLACEMENT

SUMMER HABITAT

1. **Summer Habitat Creation / Enhancement** - Indiana bat summer habitat will be created and enhanced in the Action Area through wetland and forest mitigation focused on riparian corridors and existing forest blocks to provide habitat connectivity. The following areas and possibly others will be investigated for wetland and forest mitigation to create and enhance summer habitat for the Indiana bat: Pigeon Creek, Patoka River bottoms, East Fork of

the White River, Thousand Acre Woods, White River (Elnora), First Creek, American Bottoms, Garrison Chapel Valley, Beanblossom Bottoms, White River (Gosport), White River (Blue Bluff), and Bradford Woods. Where appropriate, mitigation sites will be planted with a mixture of native trees that is largely comprised of species that have been identified as having relatively high value as potential Indiana bat roost trees. Tree plantings will be monitored for 5 years after planting to ensure establishment and protected in perpetuity via conservation easements.

2. **Wetland MOU** - Wetlands will be mitigated at ratios agreed on in the Wetland MOU (dated January 28, 1991). Wetland replacement ratios are as follows:
 - a. Farmed 1 to 1
 - b. scrub / shrub and palustrine / lacustrine emergent 2 - 3 to 1 depending upon quality
 - c. bottomland hardwood forest 3 – 4 to 1 depending upon quality
 - d. exceptional, unique, critical (i.e. cypress swamps) 4 and above to 1 depending upon quality.
3. **Forest Mitigation** - The Tier 1 Forest and Wetland Mitigation and Enhancement Plan identifies the general location of potential mitigation sites for upland and bottomland forests. Preference will be given to areas contiguous to large forested tracts that have recorded federal and state listed species. The actual mitigation sites implemented will be determined in Tier 2 in consultation with the Service and other environmental review agencies. Coordination with the environmental review agencies will assure that these forest mitigation sites are strategically situated in biologically attractive ecosystems. Forest impacts will be mitigated at a ratio of 3 to 1. All forest mitigation lands will be protected in perpetuity via conservation easements.

C. CONSERVATION / PRESERVATION

WINTER HABITAT

1. **Hibernacula Purchase** - Opportunities will be investigated to purchase from “willing sellers”, an Indiana bat hibernaculum(a) including associated autumn swarming/spring staging habitat. After purchase and implementation of all management efforts, the hibernaculum(a) and all buffered areas will be turned over to an appropriate government conservation and management agency for protection in perpetuity via conservation easements.
2. **Hibernacula Protection** – With landowner permission, investigations will be coordinated with the USFWS on acquiring easements to erect bat-friendly angle-iron gates. These gates restrict access to the caves preventing disturbance of hibernacula, while maintaining airflow at the entrances of known hibernacula within the Action Area. Gates will be constructed according to designs from the American Cave Conservation Association. Effects of gates on

water flow and flash flooding debris will be carefully evaluated before gates are installed. Other structures (e.g., perimeter fencing) or techniques (e.g., alarm systems and signs) may be used.

AUTUMN/SPRING HABITAT

3. **Autumn/Spring Habitat Purchase** - Any hibernaculum(a) purchased as part of conservation for Indiana bat winter habitat will include associated autumn swarming/spring staging habitat to the maximum extent practicable. In addition, some parcels containing important autumn swarming/spring staging habitat may be acquired near key hibernacula regardless of whether the hibernacula are acquired themselves. Any acquired autumn swarming/spring staging habitat would be turned over to an appropriate government conservation and management agency for protection in perpetuity via conservation easements.

SUMMER HABITAT

4. **Summer Habitat Purchase** - Investigations will be coordinated with the USFWS on purchasing lands in the Action Area from "willing sellers" to preserve summer habitat. Any acquired summer habitat area would be turned over to an appropriate government conservation and management agency for protection in perpetuity via conservation easements.

D. EDUCATION / RESEARCH

WINTER HABITAT

1. **New Hibernacula** - Newly discovered Indiana bat hibernacula (caves and/or mines) will be fully investigated (e.g., temperature and humidity dataloggers may be installed) and surveyed by experts in the field prior to construction of the Interstate and again 1 year and 3 years post-construction. All information will be provided to the USFWS in a timely manner.
2. **Monitor Gated Caves** - All caves that have gates erected as mitigation for this project will have their temperature, humidity, and populations monitored before and for 3 years after gate installation. Infra-red video monitoring or other techniques deemed acceptable by USFWS will be conducted for 2 nights at each newly installed cave gate to ensure the bats are able to freely ingress and egress. Data acquisition will use a number of data loggers minimizing the need for entry into these caves. All precautionary measures will be taken to minimize potential impacts to hibernating Indiana bats.
3. **Cave Warning Signs** - Where deemed appropriate by USFWS, the following may be done: signs will be posted that warn the public and discourage cave entry at hibernacula within/near the Action Area. Signs should be placed so that

they do not block air flow into the cave and do not draw attention to the entrance and attract violators (USFWS 1999). Also, light-sensitive dataloggers may be placed within the caves to assess the effectiveness of the warning signs at deterring unauthorized entries. Permission from the landowners must be obtained before erecting such signs and installing dataloggers.

4. **Biennial Census** – Total funding of \$50,000 will be provided to supplement the biennial winter census of hibernacula within/near the proposed Action Areas.

AUTUMN/SPRING HABITAT

5. **Autumn/Spring Habitat Research** - Total funding of \$125,000 will be provided for research on the relationship between quality autumn/spring habitat near hibernacula and hibernacula use within/near the Action Area. This research should include methods attempting to track bats at longer distances such as aerial telemetry or a sufficient ground workforce. A research work plan will be developed in consultation with the USFWS.

SUMMER HABITAT

6. **Mist Netting** - A plan for surveying, monitoring, and reporting will be developed and conducted in consultation with and approved by USFWS. This mist netting research will be beyond Tier 2 sampling and monitoring requirements. Forty to fifty mist netting sampling sites are anticipated. Surveys will be completed before construction and monitoring will be completed for the first 5 years after construction begins. If Indiana bats are captured, attempts will be made to locate roost trees using radio-tracking. Documentation will include annual reports.

GENERAL

7. **Pamphlet** - Total funding of \$25,000 will be provided for the creation of an educational pamphlet and/or other educational materials to inform the public about the presence and protection of bats in Indiana, particularly the Indiana bat.
8. **Rest Areas** - Rest areas will be designed to educate the public on the presence and protection of sensitive species and habitats. Attractive displays near picnic areas and buildings will serve to raise public awareness as they utilize the Interstate. Information on the life history of the Indiana bat, protecting karst, and protecting water quality will be included in such displays.
9. **Visitor's Center** - If reasonable, an interchange will be constructed that provides access to a proposed Visitor's Center at the Patoka River National Wildlife Refuge.

10. **GIS Information** - GIS maps and databases developed and compiled for use in proposed I-69 planning will be made available to the public. This data provides information that can be used to determine suitable habitats, as well as highlight other environmental concerns in local, county, and regional planning. Digital data and on-line maps are being made available from a server accessed on the Indiana Geological Survey website at Indiana University: <http://igs.indiana.edu/arcims/statewide/index.html>.

BALD EAGLE (*Haliaeetus leucocephalus*)

A. CONTEXT SENSITIVE SOLUTIONS

1. **Alignment Planning** - Where reasonable, Tier 1 has located Interstate alignments away from environmentally sensitive areas (nests, core forests, wetlands, etc.). INDOT will closely coordinate with Indiana DNR biologists regarding the locations of nests near and within the Action Area. Alignments will be shifted away from eagle nests when feasible.
2. **Medians and Alignments** – Variable-width medians and Independent Alignments will be used where appropriate to minimize impacts to some habitats and provide context sensitive solutions where possible. This may involve vertical and horizontal shifts in the north-south bound highways.
3. **Carriion Removal** – Standard operating procedures will be employed to remove carrion from the Interstate in a timely manner to reduce the potential for vehicle/eagle collisions. Appropriate INDOT Maintenance Units in Districts where proposed I-69 crosses or comes near to the Patoka River, East Fork of the White River, and West Fork of the White River will be given notice for special attention to this measure, especially in winter.
4. **Water Quality** - Water contamination will be avoided/minimized by the following:
 - a. **Equipment Service** - Equipment servicing and maintenance areas will be designated to areas away from streambeds.
 - b. **Equipment Maintenance** - Construction equipment will be maintained in proper mechanical condition.
 - c. **Spill Prevention/Containment** – The design for the roadway will include appropriate measures for spill prevention/containment.
 - d. **Herbicide Use Plan** - The use of herbicides will be minimized in environmentally sensitive areas, such as riparian areas that are protective of bald eagles and their prey.
 - e. **Revegetation** - Revegetation of disturbed areas will occur in accordance with INDOT standard specifications. Woody vegetation will only be utilized beyond the clear zone. Revegetation of disturbed soils in the right-

of-way and medians will utilize native grasses and wildflowers, as appropriate, similar to the native seed mixes of other nearby states.

- f. **Bridge Design** – Where feasible and appropriate, bridges will be designed with none or a minimum number of in-span drains. To the extent possible, the water flow will be directed towards the ends of the bridge and to the riprap drainage turnouts.
5. **Erosion Control** - Temporary erosion control devices will be used to minimize sediment and debris. Timely revegetation after soil disturbance will be implemented and monitored. Revegetation will consider site specific needs for water and karst. Erosion control measures will be put in place as a first step in construction and maintained throughout construction.
6. **Parking and Turning Areas** - Parking and turning areas for heavy equipment will be confined to sites that will minimize soil erosion and tree clearing, and will avoid environmentally sensitive areas, such as karst.
7. **Tree Clearing** - Tree clearing will be kept to a minimum beyond the construction limits, but within the right-of-way.
8. **Floodplains** – Where reasonable and appropriate, floodplains and oxbows will be bridged to protect environmentally sensitive areas. The Patoka River floodplain will be bridged in its entirety, thus minimizing impacts to many different habitats.
9. **Vegetative Screens** – Where feasible and appropriate, a vegetative screen (i.e., trees) will be maintained within INDOT owned R/W between any nearby eagle nests and the Interstate to minimize visual and auditory disturbances during and after construction.

B. RESTORATION / REPLACEMENT

1. **Forest and Wetland Mitigation** - Wetland and forestland impacted by the project will be mitigated as part of the Forest and Wetland Mitigation Plan. Potential mitigation sites include areas near the Patoka River bottoms, Beanblossom Bottoms, East Fork of the White River, White River (Elnora), White River (Gosport), White River (Blue Bluff), and possibly others.
2. **Wetland MOU** - Wetlands will be mitigated at ratios agreed on in the Wetland MOU (dated January 28, 1991). Upland forests will be mitigated at a 3:1 ratio. Wetland replacement ratios are as follows:
 - a. farmed 1 to 1
 - b. scrub / shrub and palustrine / lacustrine emergent 2 - 3 to 1 depending upon quality
 - c. bottomland hardwood forest 3 - 4 to 1 depending upon quality
 - d. exceptional, unique, critical (i.e. cypress swamps) 4 and above to 1 depending upon quality.

3. **Forest Mitigation** - The Tier 1 Forest and Wetland Mitigation and Enhancement Plan identifies the general location of potential mitigation sites for upland and bottomland forests. Preference will be given to areas contiguous to large forested tracts that have recorded federal and state listed species. The actual mitigation sites implemented will be determined in Tier 2 in consultation with the Service and other environmental review agencies. Coordination with environmental review agencies will assure that these forest mitigation sites are strategically situated in biologically attractive ecosystems. Forest impacts will be mitigated at a ratio of 3 to 1. Where, tree planting is part of forest mitigation near large water bodies and rivers, native tree species that form large, open-branched crowns (e.g., eastern cottonwood and sycamore) will be included in the species mix. Tree plantings will be monitored for 5 years to ensure successful establishment. Mitigation lands will be protected in perpetuity via conservation easements.
4. **Platforms and Perches** - Mitigation sites will be evaluated for inclusion of nesting platforms and artificial perch sites.

C. CONSERVATION / PRESERVATION

Habitat Purchase - Purchasing lands in the Action Area from "willing sellers" to preserve habitat will be investigated. The listed areas and possibly others will be investigated for purchase and conservation. Special interest will be given to the Patoka River bottoms, East Fork of the White River, and Lake Monroe. Any acquired habitat would be turned over to the appropriate government conservation and management agency for protection in perpetuity via conservation easements.

D. EDUCATION / RESEARCH

1. **Pamphlet** – Total funding of \$25,000 will be provided for the creation of an educational pamphlet and/or other educational materials to inform the public about the recovery, presence, and protection of bald eagles, including measures to reduce harm, harassment risks, and water quality.
2. **Rest Areas** - Rest areas will be designed to educate the public on the presence and protection of sensitive species and habitats. Attractive displays near picnic areas and buildings will serve to raise public awareness as they utilize the Interstate. Information on life history of the bald eagle, recovery in Indiana, protecting water quality, and limiting disturbance will be included in such displays.
3. **Visitor's Center** - If reasonable, an interchange will be constructed that provides access to a proposed Visitor's Center at Patoka River NWR.
4. **GIS Information** - GIS maps and databases developed and compiled for use in proposed I-69 planning will be made available to the public. This data provides information that can be used to determine suitable habitats for the bald eagle, as

well as highlight other environmental concerns in local, county, and regional planning. Digital data and on-line maps are being made available from a server accessed on the Indiana Geological Survey (IGS) website at Indiana University: <http://igs.indiana.edu/arcims/statewide/index.html>.

Action Areas

The proposed project involves the construction, operation, and maintenance of an Interstate highway, I-69, from Indianapolis to Evansville through southwestern Indiana. The “action area” is defined by regulation as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR § 402.02). The action area is not limited to the “footprint” of the action nor is it limited by the Federal agency’s authority. Rather, it is a biological determination of the reach of the proposed action on listed species. The FHWA, INDOT, and the Service’s BFO jointly developed two seasonally based action areas for the Indiana bat and one for the bald eagle as is described in the following subsections.

Indiana Bat Action Areas

The “**Summer Action Area**” for the Indiana bat is a 5-mile band, 2.5 miles either side of the proposed centerline of Alternative 3C, that runs the entire length of the proposed project (Figure 3). This distance was chosen based on a study in Illinois (Gardner et al. 1991a) that found the maximum distance an Indiana bat traveled from its daytime roost tree to its original capture site was 2.5 miles (4.1 km). In addition, the 2.5-mile distance is consistent with unpublished data from Indiana bat studies conducted at the Jefferson Proving Grounds and the Indianapolis Airport in Indiana (Pruitt 1995, 3D/International 1995). The entire length of the proposed project contains suitable summer roosting and foraging habitat, thus a Summer Action Area width of 2.5 miles on either side of the proposed centerline (5 miles wide) will encompass summer habitat being used by Indiana bats that might be affected by the proposed I-69 project. The corridor is approximately 2000 feet wide in most places, but is narrowed in some instances to avoid sensitive environmental areas.

The Service defines the “**Winter Action Area**” for Indiana bats as collectively being the total area that falls within a 5-mile radius centered on each of the known Indiana bat hibernacula that have entrances located within 5 miles of the proposed 3C corridor (Figure 3). [NOTE: The BFO expounded upon the definition of the Winter Action Area that was in the Tier 1 BA to add clarity and to allow for the possibility of further modifications that may be warranted based on new information collected during Tier 2 studies]. The circular areas that form the Winter Action Area are assumed to encompass 1) all of the known cave entrances and connected subterranean passages of each hibernaculum, 2) all of the recharge areas (e.g., sinkholes, and sinking stream basins) of cave streams that run through or are otherwise hydrologically connected to each hibernaculum (if known), and 3) all above-ground habitat used by Indiana bats while foraging and roosting during the fall swarming and early spring staging periods (e.g., forests, open woodlots, tree-lined fencerows, pastures, old fields, wetlands, and surface waters). Currently, the Winter Action Area includes 10 known Indiana bat hibernacula, which are all natural caves located in the Crawford Upland and Mitchell Plateau physiographic regions in Monroe and Greene counties. The 5-mile radius centered on hibernacula was chosen because Indiana bats have been documented roosting and foraging up to a maximum distance of approximately 5 miles (8 km) from their winter hibernacula during the fall swarming period (Rommé et al. 2002).

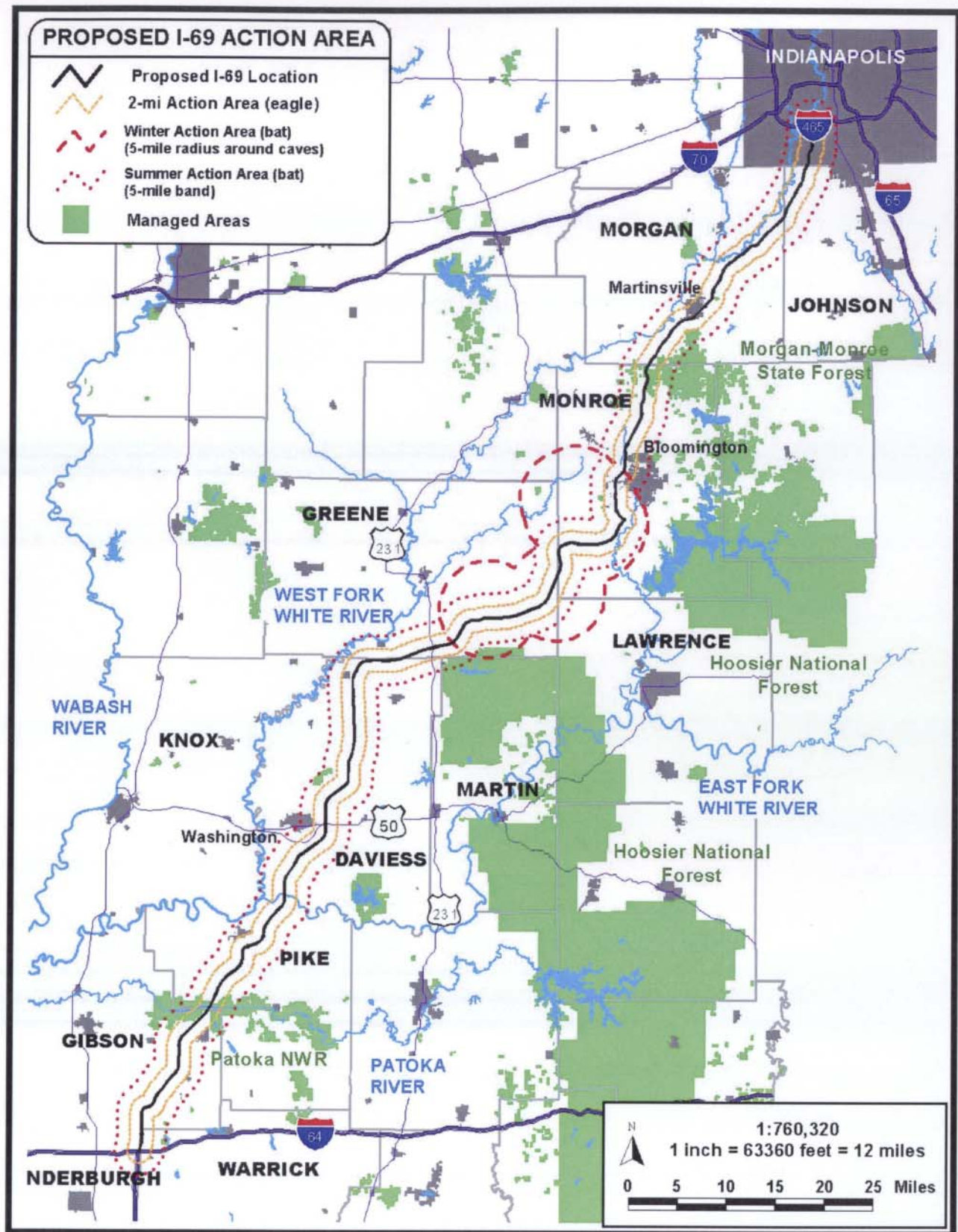


Figure 3. I-69 Action Areas for the Indiana bat and bald eagle.

For this consultation, the Service has assumed no Indiana bats, their hibernacula and associated karst systems, their prey, or surrounding habitat will be directly or indirectly affected beyond 5 miles from the proposed 3C corridor of I-69. However, if new information proves one or more of these assumptions are not valid, then the radii of all hibernacula will be adjusted accordingly or adjusted singly on a case-by-case basis, which ever is warranted and appropriate, during subsequent consultations. Likewise, if an additional Indiana bat hibernaculum(a) is discovered during Tier 2 investigations or surveys of caves and underground mines, then it will be treated similarly and given full consideration during project section-specific consultations with the Service.

There is no designated Critical Habitat for the Indiana bat within the Summer or Winter Action Areas for I-69. However, one hibernaculum (a natural cave) that has been designated as Critical Habitat for the Indiana bat is located approximately 6 miles from the proposed 3C corridor (i.e., 1 mile beyond the Winter Action Area) in eastern Greene County. During informal consultation with the Service's BFO and prior to the release of the Tier 1 DEIS, the FHWA and INDOT agreed to shift their preliminary alignment of Alternative 3 further away to avoid adverse affects to Indiana bats using this cave.

Bald Eagle Action Area

The action area for the Federally threatened bald eagle is a band that includes 1 mile on either side of the proposed I-69 corridor (Figure 3). The Northern States Bald Eagle Recovery Plan, developed by the Service (USFWS 1983a), details three management zones, or buffer zones, that should be established around bald eagle nests to avoid disturbing the eagles. These buffer zones become less restrictive to human activity as the distance from the nest increases. The primary zone extends 330 feet from the nest, the secondary zone 660 feet, and the tertiary zone 1,320 feet (1/4 mile) to 2,640 feet (1/2 mile). The Bald Eagle Action Area was extended to 1 mile on either side of the proposed corridor, which is twice the distance of the standard tertiary zone, and four times the recommended distance from winter night roost sites. Therefore, the action area band is a total of approximately 2.4 miles wide, and follows the length of the proposed Interstate from Indianapolis to Evansville. No direct or indirect effects from I-69 are expected to occur on bald eagles beyond this distance. Because no Critical Habitat has been designated for the bald eagle, none will be adversely modified by this project.

The Service's Section 7 Consultation Approach

Because the FHWA is following a tiered process for the I-69 project, where complete and detailed information regarding specific alignments and anticipated impacts is not available for analysis until after the Tier 1 corridor decision has been finalized and Tier 2 studies have been completed on all six project sections, the Service believes that a programmatic consultation approach is appropriate for this project.

By taking a programmatic consultation approach, the Service will be able to complete one comprehensive and conservative effects analysis, up front in Tier 1 for the entire I-69 project rather than repeating the same analyses for each of the six subsequent Tier 2 Project Sections. Therefore this approach should also increase the efficiency of the section 7 consultation process for I-69. Another benefit of completing this analysis up front in an overall project or "programmatic" consultation document is that the anticipated effects common to each of the

forthcoming Tier 2 Project Section alignments can be added into the environmental baseline prior to their actual completion. This provides predictability for the FHWA and INDOT as they can be assured that the effects of their future Tier 2, I-69-related actions have already been broadly accounted for.

In Tier 1, uncertainty exists as to the specific impacts that will occur when the entire I-69 alignment is eventually finalized. Therefore, the Service will provide the benefit of the doubt to the listed species and use "reasonable worst case" assumptions when developing the programmatic-level biological opinion. This results in the Service examining the greatest levels of impacts that can occur from implementing the conservation measures proposed in the Tier 1 BA. This evaluation is then refined through the Tier 2 Project Section-level consultations. This approach will ensure that the FHWA can fulfill its responsibilities under section 7(a)(2) of the Act to "insure" that actions implemented under their I-69 "program" are not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of designated critical habitat.

The Service will implement an appended programmatic approach for I-69, which is a two-stage consultation process. The first stage involves the Service developing a programmatic biological opinion for I-69 that analyzes potential effects from a landscape-level to an individual animal level that may result from fully implementing the proposed design criteria developed for the entire I-69 project from Evansville to Indianapolis, Indiana. This stage is being completed near the end of Tier 1. The second stage involves the FHWA developing appropriate project section-specific documentation (e.g., Tier 2 biological assessments for each project section) that addresses the specific impacts associated with each section of I-69. Upon completion of the Service's project section-specific review and analysis, the associated documentation is physically "appended" to the programmatic biological opinion. The programmatic biological opinion, together with the appended documentation for each project section, encompasses the complete consultation document for each Tier 2 Project Section of I-69.

To ensure the impacts of take associated with the final alignments chosen for each of the six forthcoming Tier 2 Project Sections of I-69 are appropriately minimized and that the exemption of incidental take is appropriately tracked and documented, the FHWA and the Service will implement an appended programmatic consultation approach for this project. Under this approach, the Service's Programmatic Biological Opinion and Incidental Take Statement for I-69 will consider and quantify reasonable amounts of anticipated incidental take for Indiana bats and bald eagles for the entire I-69 project from Evansville to Indianapolis during Tier 1. However, all impacts associated with each Tier 2 Project Section which have not yet been specifically identified and those which will impact Indiana bat or bald eagle habitat will be individually reviewed to determine if they are consistent with the programmatic Incidental Take Statement's reasonable and prudent measures and associated terms and conditions, and to ensure that once specific alignments are identified, the site-specific impacts of the resulting incidental take are minimized. If an individual Tier 2 Project Section is found to be consistent with the programmatic consultation it will be appended to the programmatic Biological Opinion and Incidental Take Statement, along with any project section-specific reasonable and prudent measures and terms and conditions that are needed to fulfill the requirements of section 7(a)(2).

Details on how specific impacts associated with each Tier 2 Project Section will be reported and documented are included in the attached INCIDENTAL TAKE STATEMENT.

II. STATUS OF THE SPECIES

Indiana Bat

This section is a discussion of the range-wide status of the Indiana bat and presents biological and ecological information relevant to formulating the biological opinion. It includes information on the species' life history, its habitat and distribution, and the effects of past human and natural factors that have led to the current status of the species.

The Indiana bat was officially listed as an endangered species on March 11, 1967 (Federal Register 32[48]:4001) under the Endangered Species Preservation Act of October 15, 1966 (80 Stat. 926; 16 U.S.C. 668aa[c]). The Endangered Species Act of 1973 extended full protection to the species. The Service has published a recovery plan (USFWS 1983b) which outlines recovery actions. Briefly, the objectives of the plan are to: (1) protect hibernacula; (2) maintain, protect, and restore summer maternity habitat; and (3) monitor population trends through winter censuses.

Thirteen winter hibernacula (11 caves and two mines) in six states were designated as Critical Habitat for the Indiana bat in 1976 (Federal Register, Volume 41, No. 187). In Indiana, two winter hibernacula (a cave in Crawford County and a cave in Greene County) were Designated Critical Habitat. Although the Critical Habitat in Greene County is within the general vicinity of the current proposed project, it is over 6 miles from the proposed working alignment of Alternative 3C and not considered to be within the Indiana bat Action Areas for I-69.

In the 2001 hibernacula census, the total known Indiana bat population was an estimated 380,000, down from 880,000 bats in 1960 (Table 3), and approximately half of these hibernated in eight Priority One hibernacula (excluding Dixon Cave, KY which may not have reached the Priority One threshold) (Clawson 2002). Censuses began in the late 1950s and since then many winter populations have decreased especially in Kentucky and Missouri. Overall, populations have declined 57% since the 1960s (Clawson 2002). Kentucky suffered dramatic losses because of change in microclimate due to poor cave gate design in two of the three most important hibernacula. Numbers continue to decline in Kentucky. Despite recovery efforts, Indiana bats in Missouri have declined steadily and drastically (USFWS 1999). Cumulatively, the southern population (Alabama, Arkansas, Kentucky, Missouri, Tennessee, and Virginia) is down 80%, while the northern region (Illinois, Indiana, New York, Ohio, Pennsylvania, West Virginia) is up 30% (Clawson 2002). Over the last 40 years in the southern range, Priority One hibernacula populations have dropped 82%, Priority Two declined by 77%, and Priority Three decreased by 57%. Proportions of the southern population in different priority hibernacula have remained similar, three-quarters to two-thirds in Priority Ones, a quarter in priority Twos, and a doubling in Priority Threes from 3% to 6%. In the northern region in the last 40 years, the hibernacula population trends have behaved differently: Priority One dropped 29%, Priority Two increased dramatically by 216%, and Priority Three increased by 20%. The population proportions in different priority hibernacula have shifted considerably, with the Priority One and Priority Two

Table 3. Estimated populations of hibernating Indiana bats by state* (Clawson 2002).

State	1960/1970	~1980	~1990	2000/2001
Alabama	350	350	350	250
Arkansas	15,000	15,000	4,500	2,500
Illinois	14,800	14,800	14,900	19,300
Indiana	160,300	155,200	163,500	173,100
Kentucky	248,100	102,200	78,700	47,900
Missouri	399,000	342,000	150,100	73,000
New York	20,200	21,100	26,800	34,900
Ohio	150	3,600	9,500	9,800
Pennsylvania	700	700	400	700
Tennessee	20,100	20,100	16,400	10,200
Virginia	3,100	2,500	1,900	1,000
West Virginia	1,500	1,200	6,500	9,700
Total	883,300	678,750	473,550	382,350

*Due to inconsistent records, population estimates for a particular period were extrapolated from the survey nearest to the year indicated, either prior to or subsequent to that year; therefore all caves are represented in each period.

hibernacula proportions reversing. Priority Ones dropped from three-quarters to well below one-half and Priority Twos increased from one-quarter to over one-half of the southern regional population, while Priority Threes have remained constant in number and proportion (Clawson 2002).

A variety of factors have contributed to Indiana bat population declines (USFWS 1983b). Sometimes their winter hibernacula are flooded, ceilings of the hibernacula collapse, or cold temperatures kill the bats through hypothermia. Exclusion of bats from hibernacula through blocking of entrances, installation of gates that do not allow for bat ingress and egress, disruption of cave air flow, and human disturbance during hibernation have been documented causes of Indiana bat declines. Because many known threats are associated with hibernation, protection of hibernacula has been a management priority.

Despite the protection of most major hibernacula, population declines have continued. Continued population declines of Indiana bats, in spite of efforts to protect hibernacula, have led scientists to the conclusion that additional information on summer habitat is needed (Rommé et al. 1995). In addition to increased focus on summer habitat, attention is also being directed to pesticide contamination. Insecticides have been known or suspected as the cause of a number of bat die-offs in North America, including endangered gray bats (*Myotis grisescens*) in Missouri (Clark et al. 1978). The insect diet and longevity of bats also exposes them to persistent organochlorine chemicals which may bioaccumulate in bat tissue and cause sub-lethal effects such as impaired reproduction.

Description and Distribution

The Indiana bat is a medium-sized bat with a head and body length that ranges from 41 to 49 mm. There are no recognized subspecies. The species range includes much of the eastern half of the United States, from Oklahoma, Iowa, and Wisconsin east to Vermont, and south to northwestern Florida. The Indiana bat is migratory, and the above described range includes both winter and summer habitat. The winter range is associated with regions of well-developed

limestone caverns. Major populations of this species hibernate in Indiana, Kentucky, and Missouri. Smaller winter populations have been reported from Alabama, Arkansas, Georgia, Illinois, Maryland, Mississippi, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Tennessee, Virginia, and West Virginia. More than 85% of the entire known population of Indiana bats hibernates in only nine caves.

Life History

The average life span of the Indiana bat is 5 to 10 years, but banded individuals have lived up to 14 and 15 years (IDNR unpublished, NatureServe 2002). Female survivorship in an Indiana population was 76% for ages 1 to 6 years and 66% for ages 6 to 10 years. Male survivorship was 70% for ages 1 to 6 years and 36% for ages 6 to 10 years (Humphrey and Cope 1977).

Summering Indiana bats (males and females) roost in trees in riparian, bottomland, and upland forests. Roost trees generally have exfoliating bark which allows the bat to roost between the bark and bole of the tree. Cavities and crevices in trees also may be used for roosting. A variety of tree species are known to be used for roosts including (but not limited to) silver maple (*Acer saccharinum*), sugar maple (*Acer saccharum*), shagbark hickory (*Carya ovata*), shellbark hickory (*Carya laciniata*), bitternut hickory (*Carya cordiformis*), green ash (*Fraxinus pennsylvanica*), white ash (*Fraxinus americana*), eastern cottonwood (*Populus deltoides*), northern red oak (*Quercus rubra*), post oak (*Quercus stellata*), white oak (*Quercus alba*), shingle oak (*Quercus imbricaria*), slippery elm (*Ulmus rubra*), American elm (*Ulmus americana*), and sassafras (*Sassafras albidum*) (Rommé et al. 1995). At one site in southern Indiana, black locust (*Robinia pseudoacacia*) was used extensively by roosting bats (Pruitt 1995). Structure is probably more important than the species in determining if a tree is a suitable roost site; and tree species which develop loose, exfoliating bark as they age and die are likely to provide roost sites. Male bats disperse throughout the range and roost individually or in small groups. In contrast, reproductive females form larger groups, referred to as maternity colonies in which they raise their offspring.

Females arrive in summer habitat as early as April 15. Temporary roosts are often used during spring until a maternity roost with large numbers of adult females is established. Indiana bats arrived at maternity roosts in April and early May in Indiana, with substantial numbers in mid-May. Most documented maternity colonies have 50 to 100 adult bats (USFWS 1999). Fecundity is low; and female Indiana bats produce only one young per year in late June to early July. Young bats can fly between mid-July and early August, at about 4 weeks of age. Mortality between birth and weaning has been found to be about 8% (Humphrey et al. 1977, NatureServe 2002). Most males stay near hibernacula (i.e., caves and mines) and roost individually or in small groups (Whitaker and Brack 2002). The later part of the summer is spent accumulating fat reserves for fall migration (USFWS 1999).

When arriving at their traditional hibernacula in August-September, Indiana bats "swarm". Some male bats may begin to arrive at hibernacula as early as July. Females typically arrive later and by September numbers of males and females are almost equal. Swarming is a critical part of the life cycle when Indiana bats converge at hibernacula, mate, and forage until sufficient fat reserves have been deposited to sustain them through the winter (Cope et al. 1977, USFWS 1983b). Swarming behavior typically involves large numbers of bats flying in and out of cave

entrances throughout the night, while most of the bats continue to roost in trees during the day. Body weight may increase by 2 grams within a short time, mostly in the form of fat (BLA 2003). Swarming continues for several weeks and copulation occurs on cave ceilings near the cave entrance during the latter part of the period. (USFWS 1991 b, USFWS 1999). The time of highest swarming activity in Indiana and Kentucky has been documented as early September (Cope et al. 1977). By late September many females have entered hibernation, but males may continue swarming well into October in what is believed to be an attempt to breed with late arriving females. Research is needed to determine how far bats will forage in the fall. Most bats tracked have stayed within 2 to 3 miles of the hibernacula, but some have been found up to 4.2 miles away (Rommé et al. 2002). Studies suggest that the majority of foraging habitat in spring and autumn is within 2 mi of the hibernacula, but extends to 5 miles. Therefore, it is not only important to protect the caves that the bats hibernate in, but also to maintain and protect the quality and quantity of roosting and foraging habitat within 5 miles of each Indiana bat hibernaculum. Additional studies of fall swarming behavior are warranted to gain a better understanding of the bats' behavior and habitat needs during this part of its annual life cycle (Rommé et al. 2002).

During swarming, males are active over a longer period of time at cave entrances than females, probably to mate with females as they arrive. Females may mate their first autumn, whereas males may not mature until the second year (USFWS 1999). After mating, females soon enter into hibernation. Most bats are hibernating by the end of November, but hibernacula populations may continue to increase (USFWS 1999). Indiana bats cluster and hibernate on cave ceilings in densities of approximately 300-484 bats per square foot, from approximately October through April. Hibernation facilitates survival during winter when prey (i.e., insects) is unavailable. The season of hibernation may vary by latitude and annual weather conditions. Clusters may protect central individuals from temperature change and reduce sensitivity to disturbance (NatureServe 2002). Like other cave bats, the Indiana bat naturally arouses at intervals of 7-14 days (Dr. John Whitaker, Jr. – per. comm.) during hibernation (Sealander & Heidt 1990). Arousals are more frequent and longer at the beginning and end of the hibernation period (Sealander & Heidt 1990). Limited mating occurs throughout the winter, and in early April as bats emerge (USFWS 1999).

After hibernation ends in late March or early April, most Indiana bats emerge, and forage for a few days or weeks near their hibernaculum before migrating to their traditional summer roosting areas. Female Indiana bats emerge first from hibernation in late March or early April, followed by the males. The timing of annual emergence may vary across their range depending on latitude and annual weather conditions. Shortly after emerging from hibernation, the females become pregnant via delayed fertilization from the sperm that has been stored in their reproductive tracts through the winter (USFWS 1999). The period after hibernation but prior to spring migration is typically referred to as "staging". Most populations leave their hibernacula by late April. Migration is stressful for the Indiana bat, particularly in the spring when their fat reserves and food supplies are low. As a result, adult mortality may be the highest in late March and April.

Most bats migrate to the north for the summer, although other directions have been documented (USFWS, 1991 b, 1999). A stronger homing tendency has been observed along a north-south axis, than the east-west direction in release studies (NatureServe 2002). Females can migrate

hundreds of miles north of the hibernacula. In spring staging, males have been found almost 10 miles from the hibernacula (HNF 2000). Less is known about the male migration pattern, but many males summer near the hibernacula (Whitaker and Brack 2002, USFWS 1991 b).

Food Habits:

Indiana bats feed exclusively on flying aquatic and terrestrial insects. Diet varies seasonally and variations exist among different ages, sexes, and reproductive status (USFWS 1999). It is probable that Indiana bats use a combination of both selective and opportunistic feeding to their advantage (Brack and LaVal 1985). Reproductively active females and juveniles show greater dietary diversity perhaps due to higher energy demands. Studies in some areas have found that reproductively active females eat more aquatic insects than do juveniles or adult males (USFWS 1999), but this may be the result of habitat differences (Brack and LaVal 1985).

Lepidoptera (moths), Coleoptera (beetles), and Diptera (midges and flies) constitute the bulk of the diet (Brack and LaVal 1985). Moths (Lepidoptera) have been identified as major prey items that may be preferentially selected (Brack and LaVal 1985), but beetles (Coleoptera) and flies (Diptera) were also found significant (Brack and Tyrell 1990). Diptera taken are especially midges and other species that congregate over water, but are seldom mosquitoes. Other prey include wasps and flying ants (Hymenoptera), caddisflies (Trichoptera), brown leafhoppers and treehoppers (Homoptera), stoneflies (Plecoptera), and lacewings (Neuroptera) (Brack and LaVal 1985, USFWS 1999). Male Indiana bats summering in or near a hibernation cave eat primarily moths and beetles but feed on other terrestrial insects in lower percentages (USFWS 1999).

Indiana bats use small impoundments as well as permanent and intermittent streams for drinking water (HNF 2000). Water-filled road ruts may be used for drinking water in uplands, more commonly in the eastern portion of the range (Brack, Jr. per. comm.).

Habitat: Winter Hibernacula Habitat

Indiana bats roost in caves or mines with configurations that provide a suitable temperature and humidity microclimate (Brack et al. 2003, USFWS 1999). In many caves, suitable temperatures and therefore roosts are located near the cave entrance, but roosts may be deeper where cold air flows and is trapped. When bats arrive at hibernacula in October and November, they need a temperature of 50° F (10° C) or below (USFWS 1999). Mid-winter temperatures range from 39 to 46° F (4 to 8° C) (USFWS 1983b); however, recent data in Indiana has recorded increased use of hibernacula ranging from 41 to 44.5° F (5 to 7° C) (Brack, Jr. per. comm.). Only a small percentage of caves available meet these temperature requirements (Brack et al. 2003, USFWS 1999). Stable low temperature allows bats to maintain low metabolic rates and conserve fat reserves to survive the winter (USFWS 1999). Relative humidity of roosts usually ranges from 74% to just below saturation, although readings as low as 54% have been recorded. This may be an important factor for successful hibernation (USFWS 1999). Hibernacula often contain large populations of several species of bats. Other bat species found in Indiana hibernacula include: a number of little brown bats (*Myotis lucifugus*) and eastern pipistrelles (*Pipistrellus subflavus*); some northern long-eared bats (*Myotis septentrionalis*); and a few gray bats (*Myotis grisescens*), big brown bats (*Eptesicus fuscus*), and silver-haired bats (*Lasionycteris noctivagans*) (Brack et al. 2003).

Habitat: Summer Roosting Habitat

FEMALE

Indiana bats exhibit strong site fidelity to their traditional summer colony areas and foraging habitat, that is, they return to the same summer range annually to bear their young. (Kurta et al. 2002, Garner and Gardner 1992, USFWS 1999). Traditional summer sites that maintain a variety of suitable roosts are essential to the reproductive success of local populations. It is not known how long or how far female Indiana bats will search to find new roosting habitat if their traditional roost habitat is lost or degraded during the winter. If they are required to search for new roosting habitat in the spring, it is assumed that this effort places additional stress on pregnant females at a time when fat reserves are low or depleted and they are already stressed from the energy demands of migration and pregnancy.

Female Indiana bats generally migrate northward from the hibernacula to summer roosting areas. Indiana bat maternity colonies typically occupy multiple roosts in riparian, bottomland, and upland forests. Roost trees generally have exfoliating bark which allows the bat to roost between the bark and bole of the tree and have a southeast or south-southwest solar exposure and an open canopy. Cavities and crevices in trees also may be used for roosting. Roost tree structure is probably more important than the tree species in determining whether a tree is a suitable roost site; and tree species which develop loose, exfoliating bark as they age and die are likely to provide roost sites. Roost trees are often located on forest edges or openings with open canopy and open understory (USFWS 1999). Maternity colonies have often been found within forests that are streamside ecosystems or are otherwise within 0.6 mi (1 km) of permanent streams. Most have been found in forest types similar to oak-hickory and elm-ash-cottonwood communities. While these characteristics are typical, research is showing adaptability in habitats used. Important summer roosting and foraging habitat for the Indiana bat is often in floodplain or riparian forests but may also be in more upland areas. A telemetry study in Illinois found most maternity roosts within 1640 ft (500 m) of a perennial or intermittent stream (Hofmann 1996). Bats in Illinois selected roosts near intermittent streams and far from paved roads (Garner and Gardner 1992). However, observations have revealed habitat use nearer paved roads than previously thought (Brack, Jr. per. comm.). Recent research has shown bats using upland forest for roosting and upland forest, and pastures with scattered trees for foraging. Indiana bats prefer forests with old growth characteristics, large trees, scattered canopy gaps, and open understories (USFWS 1999, HNF 2000). The Indiana bat may persist in highly altered and fragmented forest landscapes for some unknown period of time. Instances have been documented of bats using forest altered by grazing, swine feedlot, row-crops, hay fields, residences, clear-cut harvests, and shelterwood cuts (Garner and Gardner 1992, USFWS 1999). Several roosts have been located near lightly traveled, low maintenance roads (HNF 2000), as well as near I-70 at the Indianapolis Airport (USFWS 2002). Although, Indiana bats may be more adaptable than previously thought, it still is not known how a maternity colony's stability and reproductive success responds to increasing levels of habitat alteration and fragmentation.

Suitability of a roost tree is determined by its condition (dead or alive), suitability of loose bark, tree's solar exposure, spatial relationship to other trees, and tree's spatial relationship to water sources and foraging areas. Good roost trees are species whose bark springs away from the tree on drying after dead, senescent, or injured; and living species of hickories (*Carya* spp.) and large

white oaks (*Quercus alba*) with shaggy bark. Cottonwoods are probably one of the best tree species. Many maternity colonies have been associated with oak-hickory and elm-ash-cottonwood forest types. Tree cavities, hollow portions of tree boles or limbs, and crevice and splits from broken tops have been used as roosts on a very limited basis, usually by individual bats. Roost longevity is variable due to many factors such as the bark sloughing off or the tree falling down. Some roosts may only be habitable for 1-2 years, but species with good bark retention such as slippery elm (*Ulmus rubra*), cottonwood (*Populus deltoides*), Green ash (*Fraxinus pennsylvanica*), oaks (*Quercus* spp.), and hickories (*Carya* spp.) may provide habitat 4-8 years (USFWS 1999). Trees in excess of 15.7 in (40 cm) diameter breast height (dbh) are considered optimal for maternity colonies, but trees in excess of 8.6 in (22 cm) dbh are used as alternate roosts (USFWS 2002). Females have been documented using roost trees as small as 5.5 inches.

Indiana bat roosts are ephemeral and frequently associated with dead or dying trees. Most roost trees may be habitable for only 2-8 years (depending on the species and condition of the roost tree) under natural conditions. Gardner et al. (1991b) evaluated 39 roost trees and found that 31% were no longer suitable the following summer, and 33% of those remaining were unavailable by the second summer. A variety of suitable roosts are needed within a colony's traditional summer range for the colony to continue to exist. Indiana bat maternity sites generally consist of one or more primary maternity roost trees which are used repeatedly by large numbers of bats, and varying numbers of alternate roosts, which may be used less frequently and by smaller numbers of bats. Primary roosts are often located in openings or at the edge of forest stands, while alternate roosts can be in either openings or the interior of the forest stand. Primary roosts are usually surrounded by open canopy and are warmed by solar radiation. Alternate roosts may be used when temperatures are above normal or during precipitation. Bats move among roosts within a season and when a particular roost becomes unavailable from one year to the next. It is not known how many alternate roosts must be available to assure retention of a colony within a particular area, but large, nearby forest tracts would improve the potential for an area to provide adequate roosting habitat (Callahan 1993, Callahan et al. 1997). In addition to having exfoliating bark, roost trees must be of sufficient diameter. Trees in excess of 16 in. diameter at breast height (dbh) are considered optimal for maternity colony roost sites, but trees in excess of 9 inches dbh are often used as alternate maternity roosts. Male Indiana bats have been observed roosting in trees as small as 2.5 inches dbh (Gumbert et al. 2002).

Exposure of trees to sunlight and location relative to other trees are important to suitability. Cool temperatures can delay development of fetal and juvenile young and selection of maternity roost sites may be critical to reproductive success. Dead trees with a southeast and south-southwest exposures allow warming solar radiation. Some living trees may provide a thermal advantage during cold periods (USFWS 1999). Maternity colonies use multiple roosts in both dead and living trees that are grouped. Extent and configuration of a use area is probably determined by availability of suitable roost sites. Distances between roosts can be a few meters to a few kilometers. Maternity colony movements among multiple roosts seem to depend on climatic changes, particularly solar radiation (Humphrey et al. 1977). Kurta et al. (1993) suggests movement between roosts may be the bats' way of dealing with a roost site as ephemeral as loose bark. The bat that is aware of alternate roost sites is more likely to survive the sudden,

unpredictable, destruction of its present roost than the bat which has never identified such an alternate.

Primary roosts are often located in openings or at the edge of forest stands, while alternate roosts can be in either openings or the interior of the forest stand. Primary roosts are usually surrounded by open canopy and are warmed by solar radiation. Alternate roosts may be used when temperatures are above normal or during precipitation. Shagbark hickories (*Carya ovata*) are good alternate roosts because they are cooler during periods of high heat and tight bark shields the bats from rain (USFWS 1999). Weather has been found to have profound influence on bat behavior and habitat use (Humphrey et al. 1977).

Humphrey et al. (1977) observed that each night after the sunset peak of foraging activity the bats left the foraging areas without returning to the day roosts, which indicated the use of “night” roosts. Kiser et al. (2002) found three concrete bridges on Camp Atterbury, 25 mi (40 km) south of Indianapolis, Indiana, used by Indiana bats as night roosts and to a limited extent as day roosts. Bat species using the bridges included the big brown bat (*Eptesicus fuscus*), northern myotis (*Myotis septentrionalis*), little brown myotis (*Myotis lucifugus*), Indiana bat, and eastern pipistrelle (*Pipistrellus subflavus*). The Indiana bat was the most common species, representing 51% of all bats observed, whereas the big brown bat was the second most abundant at 38%. Clusters of Indiana bats were observed night roosting under the bridges that were lactating, post-lactating, and newly volant juveniles. Bridges used were concrete-girder (multi-beam) bridges with deep, narrow expansion joints. The bridges ranged from 46 to 223 ft in length and 26 to 39 ft in width. Average daily traffic ranged from less than 10 vehicles per day to almost 5,000 vehicles per day. All used bridges were located over streams bordered by forested, riparian corridors that connected larger tracts of forest. Riparian forest did not overhang the bridges allowing solar radiation to warm the bridges; however, forest was within 9 to 16.5 ft of each bridge. Bat clusters under bridges were located over land, near the ends of the bridges. Mean ambient temperatures at night were consistently higher and less variable under bridges than external ambient temperatures. The bridges apparently act as thermal sinks. The warmer, more stable environment presumably decreases the energetic cost of maintaining high body temperature, thus promoting fetal development, milk production, and juvenile growth. Three individuals were radio-tracked to their day roosts within 0.6 to 1.2 miles from their night roost (Kiser et al. 2002).

MALE:

Many male Indiana bats appear to remain at or near the hibernacula in summer with some fanning out in a broad band around the hibernacula (Whitaker and Brack 2002). Males roost singly or in small groups in two to five roost trees similar to those used by females. Males may occasionally roost in caves. Suitable roost trees typically have a large diameter, exfoliating bark, and prolonged solar exposure with no apparent importance in regard to the tree species or whether it is upland or bottomland (Whitaker and Brack 2002). Because males typically roost individually or in small groups, the average size of their roost trees tends to be smaller than the roost trees used by female maternity colonies, and in one instance a roost tree only 2.5 inches (6.4 cm) in diameter was used (Gumbert et al. 2002). Male bats have also been observed using trees as small as 3.1 in (8 cm) dbh (USFWS 2002). Also, males are more likely than females to be found in disturbed areas; possibly because the roost trees in those areas are likely to be to

small for colony use, but still suitable for an individual roost (Brack, Jr. per. comm.). One individual was found roosting on the Hoosier National Forest within the easement of I-64 (HNF 2000). Males have shown summer site fidelity and have been recaptured in foraging areas from prior years (USFWS 1999). At Camp Atterbury in Indiana, male bats were observed using the same bridges as females for night roosts, but they roosted singly (Kiser et al. 2002).

Autumn Swarming / Spring Staging Habitat

Indiana bats use roosts in spring and fall that are similar to those used in summer (USFWS 1999). However, because habitat is used by individuals rather than colonies, sites may be much smaller (Brack, Jr. per. comm.). Females use smaller, more disturbed areas during swarming and staging than in summer in maternity colonies (Brack, Jr. per. comm.). During fall, when bats swarm and mate at their hibernacula, male bats roost in trees nearby during the day and fly to the cave during the night. Studies have found males roosting in dead trees on upper slopes and ridgetops within a few miles of the hibernacula (USFWS 1999). In Jackson County, Kentucky, research showed fall roost trees tend to be located in canopy gaps created by disturbance (logging, windthrow, prescribed burning) and along edges (HNF 2000). Fall roost trees are often exposed to sunshine (USFWS 1999). Fidelity to fall roosts has been observed, where an individual bat uses an individual roost for an average of 2 to 3 days before moving to a new tree (Gumbert et al. 2002). Bats have been observed moving among multiple roosts in an area using particular roosts alternatively (Brack, Jr. per. comm., Gumbert et al. 2002).

In the spring, upon emergence, females and some males disperse from the hibernacula. Migration within the core of the species' range is generally northward to form colonies throughout Indiana, southern Michigan, and adjoining Ohio and Illinois. Male Indiana bats remain at or near the hibernacula, although some fan out in a broad band or zone around the hibernacula (Whitaker and Brack 2002).

Spring and autumn habitat use is variable due to proximity and quantity of roosts, weather conditions, and prey availability (Rommé et al. 2002). Several studies support the idea that during the autumn and spring, bats primarily use habitat within 5 miles (8 km) of the hibernacula (Rommé et al. 2002, Brack, Jr. per. comm.). However, more studies of autumn and spring habitat use is recommended due to low sample sizes and difficulties with telemetry research techniques (USFWS 1999).

Foraging Habitat

Indiana bats forage between dusk and dawn and feed exclusively on flying insects, primarily moths, beetles, and aquatic insects. They typically forage in and around tree canopy and in openings of floodplain, riparian, and upland forests (USFWS 1999). Optimum canopy closures are 50-70% with relatively open understory (<40% of trees are 2-4.7 in (5-12 cm) dbh) (HNF 2000). Woody vegetation with a width of at least 100 ft (30 m) on both sides of a stream has been characterized as excellent foraging habitat. Streams, associated with floodplain forests and impounded water bodies, are preferred foraging habitats for pregnant and lactating Indiana bats, some of which may fly up to 1 ½ mi from upland roosts (Garner and Gardner 1992, USFWS 2002). Brack and Tyrell (1990) found that in early summer, foraging was restricted to riparian habitats. Foraging also occurs over clearings with successional vegetation, along cropland borders, fencerows, and over farm ponds. Maternity colony foraging ranges from a liner strip of

creek vegetation 0.5 mi long to a 0.75 mi foraging area along a wooded river. Bats have been observed crossing Interstate 70 in Indiana to reach foraging habitat (USFWS 2002). Bats have been documented routinely flying at least 1.25 mi (2 km) from the roost to forage and some were tracked up to 3 mi (5 km) from the roost (USFWS 2002). Foraging bats usually fly between 6 – 100 feet above ground level (USFWS 1999). In Illinois, Gardner et al. (1991a) found that forested stream corridors, and impounded bodies of water, were preferred foraging habitats for pregnant and lactating Indiana bats, which typically flew up to 1.5 miles (2.4 km) from upland roosts to forage. However the same study reported the maximum distance that any female bat flew (regardless of reproductive status) from her daytime roost to her capture site was 2.5 miles (4.2 km). Females typically utilize larger foraging ranges than males (Garner and Gardner 1992).

Bald Eagle

This section is a discussion of the range-wide status of the bald eagle (*Haliaeetus leucocephalus*) and presents biological and ecological information relevant to formulating the biological opinion. It includes information on the species' life history, its habitat and distribution, and the effects of past human and natural factors that have led to the current status of the species.

Designated as the national bird of the United States in 1782, the bald eagle nested throughout the nation. In 1940, the bald eagle was originally protected by what is now known as the Bald and Golden Eagle Protection Act (BGEPA). This law provides for the protection of the bald eagle and the golden eagle (as amended in 1962) by prohibiting the take, possession, sale, purchase, barter, offer to sell, purchase or barter, transport, export or import, of any bald or golden eagle, alive or dead, including any part, nest, or egg, unless allowed by permit (16 U.S.C. 668(a); 50 CFR 22). "Take" includes pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb (16 U.S.C. 668c; 50 CFR 22.3). On March 11, 1967, bald eagles south of the 40th parallel were listed under the Endangered Species Preservation Act of 1966. The bald eagle was also afforded protection under the Migratory Bird Treaty Act (MBTA; 16 U.S.C. 703-712) when it was amended to include native birds of prey in 1972. The bald eagle was subsequently listed as threatened under the Endangered Species Act of 1973 (ESA; 41 FR 24062 24067) on February 14, 1978 in Michigan, Minnesota, Oregon, Washington, and Wisconsin, and as endangered in the 43 remaining conterminous states. Due to the wide distribution of the bald eagle, the Service established five recovery regions to outline recovery planning goals and needs on a regional basis, leading to the development of five separate recovery plans for the species. Bald eagles in the State of Indiana are addressed in the Northern States Bald Eagle Recovery Plan, which was approved by the Service on July 29, 1983. No Critical Habitat was designated under the ESA for the bald eagle. In July 1995, as a result in wide-spread population increases, the Service down-listed the species to threatened status under the ESA throughout the lower 48 states. Then on July 6, 1999, after reaching or exceeding the recovery goals for the species, the Service proposed to remove the bald eagle from the Federal Threatened and Endangered Species List (i.e., delist it; Figure 4). Currently, the Service considers the bald eagle population to be fully recovered, even though it remains listed as a Federally threatened species in the lower 48 states. The bald eagle delisting has been delayed while a new post-delisting bald eagle disturbance permit process is being established under the Bald and Golden Eagle Protection Act. Once delisted, the ESA would require the Service to monitor the status of the bald eagle for at

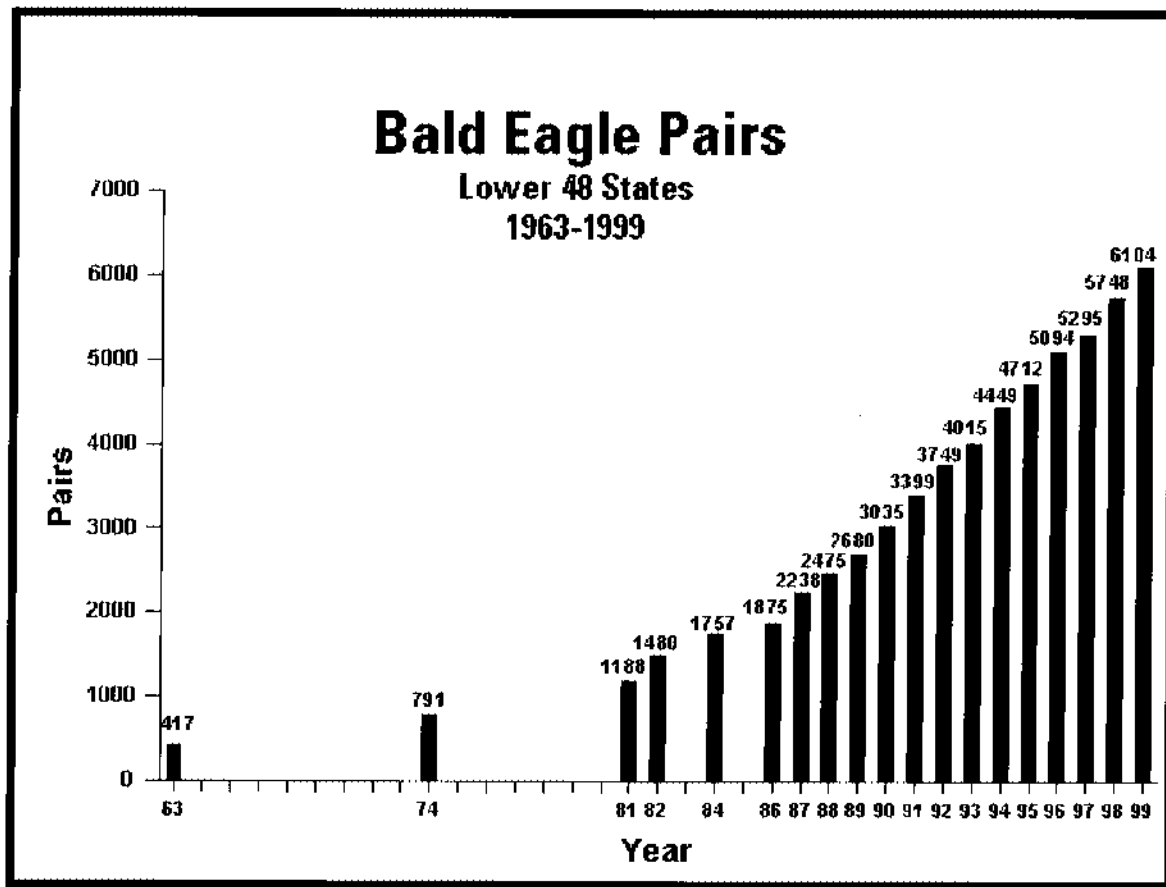


Figure 4. Pairs of nesting bald eagles in the lower 48 states, 1963 – 1999 (USFWS 2003 a).

least five years following delisting. If a delisted species is found to be at risk, the Service can review the best available information and if necessary invoke the emergency listing clause of the ESA and relist the species.

A variety of factors contributed to bald eagle population declines over the past century (USFWS 1983a), but habitat loss and pesticide use, such as DDT, were the primary causes of decline. Habitat loss first occurred during European settlement of North America. As settlers cleared the land, they removed suitable trees for bald eagle nest and roost sites, as well as habitat for their prey. Wide spread shooting of eagles was also a contributing factor to the species' decline. Bald eagle numbers began to increase in the U.S. after Federal laws were enacted to protect them, however they began to decline again in the 1940s due to the wide spread use of certain organophosphate pesticides. These pesticides, DDT being the most notable, were used during the 1940s, 1950s, and 1960s. Pesticides like DDT and their metabolites tend to bioaccumulate, or increase in concentration as they move up the food chain, and therefore are present in highest concentrations in animals at the top of their food chain, such as bald eagles. A metabolite of DDT, known as DDE, inhibits normal calcium deposition in birds when eggshells are being formed. This resulted in eggshell thinning and reproductive failure in the bald eagle and other birds. Successful reproduction virtually ceased. In 1972, the U.S. Environmental Protection

Agency (USEPA) banned the use of DDT because of its harmful environmental effects. Bald eagle populations began to increase after the ban of DDT (see Figure 4). After banning DDT and implementing recovery actions under the ESA for over 30 years including: protecting/enhancing habitat, minimizing disturbance, monitoring contaminants, and reintroducing eagles, there are now more than 6,471 pairs of bald eagles nesting in the lower 48 states and the species has recovered.

Even though bald eagle numbers have increased dramatically, continued habitat loss, accidental trauma, illegal shooting, electrocution, and poisoning remain a threat to eagles and need to be monitored. Loss of forest habitat along and near large water bodies limits the available amount of suitable nesting, perching, roosting, and foraging habitat. Degradation of water quality also continues to threaten the integrity of aquatic ecosystems and the fish the eagles need for food.

Toxic exposure to environmental contaminants also is a localized threat. Franson et al. (1995) investigated the cause of death for over 4,300 bald and golden eagle carcasses examined over a 30 year period. Because identifying cause of death depends on finding eagle carcasses in fair to good condition, and advances in diagnostic capabilities, the study results may not reflect proportional causes of death accurately. Nonetheless, Franson et al. identified accidental trauma associated with impacts with vehicles, power lines, or other structures as the leading cause of death (23% of cases). Vehicular collisions have occurred as bald eagles scavenge carrion/roadkill along roadways, particularly in winter when food is scarce. The risk of vehicular collisions is directly influenced by landcover near the road. Roadways within a dense forest corridor present more risk than those with open roadsides because eagle are limited to vertical avoidance movements. Gunshot, either accidental or on purpose, accounted for about 15% of bald eagle deaths, electrocution about 12%, and poisoning about 16% (Franson et al. 1995). Electrocution problems with bald eagles, and other raptors, are primarily associated with relatively low voltage distribution lines (below 69 kV) to residences, businesses, or other individual users (Lehman 2001). Measures such as increasing clearances between conductors and ground wires, gapping ground wires, insulating energized components, and managing perching opportunities can reduce electrocution hazards and have been implemented in some problematic areas (Lehman 2001). Many eagles have died from lead poisoning after ingesting lead bullet fragments imbedded in crippled prey or carrion. Mortality may also occur from poisoning of certain agricultural pesticides. Poly-chlorinated biphenyls (PCBs) may also be a localized source of contamination, and have been linked to reproductive failure in bald eagles. PCBs, like DDT and other pesticides, often bioaccumulate and end up in higher concentrations in animals at the top of the food chain.

Description and Distribution

The bald eagle is a large bird of prey found only in North America. The adult bald eagle is named for its white or bald (the old English word “balde” meaning white) head. The rest of the adult’s plumage is dark brown with the exception of the tail feathers which are white. Males and females are identical in color. Immature bald eagles are dark brown with some blotches of white under the wings and on the body. As the bird reaches maturity in four or five years, this mottling disappears. Young bald eagles can be confused with the similar colored golden eagle (*Aquila chrysaetos*). Juvenile bald eagles have a brownish bill and yellow feet, while adults have bright yellow eyes, bills, and feet. The body of an adult eagle is about 3 to 3 1/2 feet in length, and the

wingspan is 6 to 7 1/2 feet. Males weigh eight to nine pounds; while females weigh ten to 14 pounds.

The historic range of the bald eagle extended throughout North America, from central Alaska and Canada to northern Mexico. However, it experienced considerable decline in the south and eastern portions of its range during the 20th century. In the late 18th century, it is believed there were as many as 100,000 nesting bald eagles in the lower 48 states, but by 1963, only 417 were known in this portion of the species range. There are about 40,000 bald eagles in Alaska and none in Hawaii. After banning DDT and implementing recovery actions under the ESA for over 30 years including: protecting/enhancing habitat, minimizing disturbance, monitoring contaminants (DDT), and reintroducing eagles, there are now more than 6,471 pairs of bald eagles nesting in the lower 48 states.

Life History

Bald eagles reach sexual maturity between four to six years of age, but may be older before they first attempt to nest and breed. They are believed to mate for life. Bald eagles have a relatively long life-span and have been known to live up to 48 years in captivity and 28 years in the wild (USFWS 1983a).

Fish are the major item of the bald eagle's diet. Eagles often catch fish while flying by swooping down on them as they swim near the water's surface and snatching them up with their sharp talons. Therefore, bald eagles spend much time roosting and foraging near large water bodies where fish abound. They also feed on waterfowl, particularly those dead, crippled, or otherwise vulnerable. At some locations, often during the winter period when eagles may be away from open water, mammals that can easily be caught or scavenged may be part of the eagle's diet (USFWS 1983a). Bald eagles may fly up to 40 mph during normal flight, but they can reach speeds of 100 mph when diving for prey. Bald eagles have few natural predators.

Bald eagles generally build their nests in trees along or near their primary foraging areas, i.e., large bodies of water such as lakes, large rivers and the ocean. Their massive nests are largely composed of small tree branches placed in the crotch of a large, open-branched tree, but at in some areas they may also nest on cliffs, or very rarely on the ground. Bald eagles often prefer the largest tree in their breeding area. Adult bald eagles will often use the same breeding area during different nesting seasons. A "breeding area" is the local area associated with one territorial pair of eagles, and containing one or more nest structures. Bald eagles will also often reuse nests in subsequent years. These birds often build and use new nests near a previous nest, and several nests may accumulate in an area, although only one is used during the nesting season. With additions to the nests made annually, some may reach 10 feet across and weigh as much as 4,000 pounds. Clutch size ranges from one to three eggs. Adults will raise one to three young, the average being just above one eaglet per nesting attempt. Although bald eagles may range over great distances, they usually return to nest within 100 miles of where they were raised or hatched themselves.

Breeding and nesting phenology depends primarily on latitude. Prior to egg-laying, bald eagles engage in courtship activities and nest building. Courtship activities can involve both calls and aerial acrobatics, such as cartwheels, swoops, and chases. Nest building and refurbishing can

take place prior to courtship, even during the previous fall. During courtship and the incubation period, the eagles are most intolerant of external disturbances and may abandon the area. The most critical period for disturbances, therefore, extends from approximately one month before egg laying through incubation. In Indiana, egg laying can occur as early as early February or March, and as late as early April. Eggs are laid every other day, and incubation takes approximately 35 days. After hatching, chicks are vulnerable to inclement weather and need frequent brooding and feeding. Natural or human-caused disturbances can keep adults from nests and, depending on the weather and length of time involved, may cause weakening or death of chicks. Adults are protective of the nest site as long as one or more healthy chicks are present. The young remain in the nest for about 10 – 12 weeks, and adults often care for the young for 6 weeks to 3 months after fledging. Prior to taking their first flight young eagles may “branch,” where they hop and climb out of their nest and into nearby tree branches while flapping and strengthening their wings. Young eagles typically leave the nest or “fledge” at 11 to 12 weeks of age. Young usually fledge from early June to mid-July in Indiana. The time between egg-laying and fledgling is approximately four months and the entire breeding cycle, from initial activity at a nest through the period of fledgling dependency, is about six months.

All bald eagles, whether tolerant or intolerant, are more susceptible to human disturbance at some times during the nesting season. In southern Indiana, bald eagles are most prone to human disturbances from December or January through May or June depending on how early an individual pair begins courting and egg-laying.

Most bald eagles in Canada and the northern U.S. migrate south in the fall; however, in temperate latitudes some remain with nesting areas throughout the year. This migration is probably a result of changes in prey availability and weather conditions. The period from November to March is referred to the “wintering period,” and may overlap the beginning of the nesting season in some areas (USFWS 1983a). Wintering bald eagles occur throughout the country, but are more prevalent in the West and Midwest. An adequate food supply and suitable night roost sites are the primary factors for appropriate winter habitat. Bald eagles use a much wider variety of habitat during winter than when nesting. Some wintering sites may be used multiple times, while others are only used once. Most wintering bald eagles are found near large bodies of water. However, some spend a large amount of time in terrestrial environments, away from a large water source. At night, wintering eagles may congregate at communal roost trees, and may travel from feeding areas to specific roost sites. Roost sites are often in locations that are protected from the wind by vegetation or terrain. These protected sites help minimize energy expenditures. Human disturbance to a roost site may cause the bald eagles to abandon it (USFWS 1983a).

FANSHELL MUSSEL

The Federally endangered fanshell mussel (*Cyprogenia stegaria*) was included in the species list as potentially occurring in the project area and was analyzed in the Tier 1 BA for I-69. In the BA, the FHWA determined that I-69 from Evansville to Indianapolis was not likely to adversely affect fanshell mussels because previous surveys at the proposed crossing of the East Fork of the White River revealed that the habitat was not suitable and no live or dead mussels were found in the vicinity of the crossing. Because the Service has concurred with their “not likely to adversely affect” determination (letter dated July 21, 2003), the fanshell mussel will not be

considered further in this consultation unless new information or changes to the proposed action warrant reinitiating consultation for this species.

III. ENVIRONMENTAL BASELINE

This section is an analysis of the past effects of State, tribal, local and private actions already affecting the species within the Action Areas and the present effects within the Action Areas that will occur contemporaneously with the consultation in progress. It includes a description of the known status of Indiana bats and bald eagles and their habitats within or near the I-69 Action Areas.

The natural environments traversed by the Action Areas are summarized below. Additional information available in the I-69, Evansville to Indianapolis, Indiana, Tier 1 DEIS is hereby incorporated by reference.

Physiographic Regions

Physiographic regions are areas that have similar topography and land use. Physiographic regions provide a general view of the terrain, and resources that may be affected by the proposed Interstate. The preferred alternative, Alternative 3C, traverses portions of seven physiographic regions: **Wabash Lowland, Boonville Hills, Crawford Upland, Mitchell Plateau, Norman Upland, Martinsville Hills, and New Castle Till Plains & Drainageways** (Figure 5).

The proposed Interstate crosses the **Wabash Lowland** in portions of Gibson, Warrick, Pike, Daviess, and Green counties. Approximately 44% of the length of the Interstate (62 miles) is in this region. It is flat to rolling with wide expanses of alluvial land, some of which is lacustrine in origin. The Wabash Lowland is the largest of the southern Indiana regions and was completely covered by the Illinoian Glacier. Land use is essentially agricultural, some forest land (mostly floodplain forests), extensive wetlands (e.g. Pigeon Creek and Patoka River bottoms), and coal mining. Agriculture is the dominant land use, with over 61% of the area devoted to farming. Approximately 22–25% of the land is forested, while the remaining land area has urban and miscellaneous uses. Approximately 87% of forests are owned by farmers and private individuals. The remaining forests are owned by federal, state, county, municipal agencies, and/or timber companies.

Only a small portion in Gibson and Pike counties, 3% (4 miles), of the proposed Interstate crosses the **Boonville Hills Region**. This region is slightly hillier than the adjacent Wabash Lowland, possibly because it was not glaciated. Strip mining has been extensive in this region, and there are large areas of reclaimed or modified land in the eastern portion (Gray 2000). Land use in the Boonville Hills includes farmland, forest, and mining.

Approximately 16.5% (23 miles) of the alternative is within the **Crawford Upland Region**, primarily in Greene and Monroe counties. This region is largely unglaciated and is a rugged highland with varied elevations and v-shaped valleys with sharp ridges to u-shaped valleys with rounded ridges. Karst terrain, containing sinkholes and caves, is common. Land use is

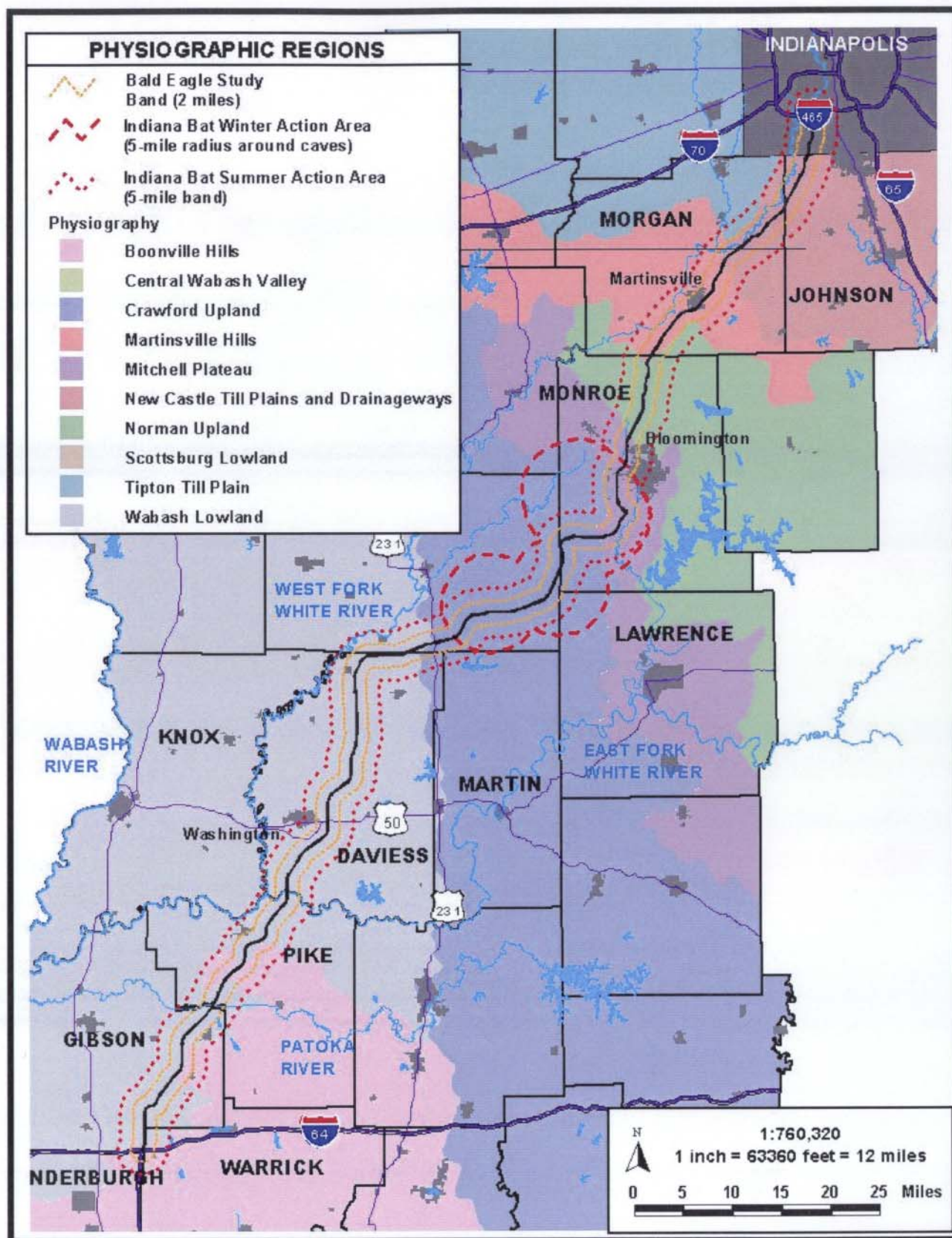


Figure 5. Physiographic regions (Gray 2000) and species Action Areas for the proposed I-69.

approximately 43% cropland, 20% pasture, and 28% woodland. Approximately 71% of the forests are owned by farmers and private individuals.

East of the Crawford Upland is the **Mitchell Plateau**. Approximately 9% (13 miles) of the proposed alternative is within this region, in Monroe County. This region is a limestone, somewhat flat to rolling plain, with many caves, sinkholes and continuous tracts of forests. There is extensive karst topography west of Bloomington. Approximately 61% of forests are owned by farmers and private individuals. Livestock, crops, timber, and limestone are this region's main commercial resources.

Approximately 9% (13 miles) of the proposed alternative is within the **Martinsville Hills Region** in Morgan County. This is a relatively small region within the study area, and more rugged than the adjacent Tipton Till Plain region to the north. The eastern and western parts of this region are more rugged than the central, which contains lacustrine and till plain areas (Gray, 2000). Predominate land use includes farmland and forest.

Approximately 5.5% (8 miles) of the proposed Interstate traverses the **Norman Upland**, in Monroe and Morgan counties. This upland region contains great local relief due to stream action over a long period of time. This resulted in long, sharp ridges, and v-shaped valleys, which in turn create rugged, picturesque hills. Prime examples of this scenic landscape are found in Brown County (Mumford and Whitaker 1982).

Finally, approximately 13% (18 miles) of the proposed Interstate passes through the **New Castle Till Plains & Drainageways** in Johnson and Marion counties. This region is a relatively flat glacial plain. It is distinguished by the number of valleys that cross it in a southerly to southeasterly radial pattern. These valleys fed the White River, the East Fork of the White River and several of its tributaries, and several forks of the Whitewater River (Gray 2000). Farmland is the predominant land use in this region.

Natural Regions

In addition to physiographic regions, the land can be categorized by natural regions. A natural region is a major, generalized unit of the landscape with a distinctive assemblage of natural features. It is part of a classification system that integrates several natural features, including: climate, soils, glacial history, topography, exposed bedrock, presettlement vegetation, species composition, physiography, and flora and fauna distribution. A "section" is a subunit of a natural region where sufficient differences are evident, such that recognition is warranted (Homoya et al. 1985). Natural regions are similar to physiographic regions, but while physiographic regions may give information on predominant land use, natural regions may give more information about native plant and animal species. Some natural regions have a similar corresponding physiographic region, while some may be unique to the classification system.

The proposed 3C corridor of I-69 crosses five natural regions: **Southwestern Lowlands, Southern Bottomlands, Shawnee Hills, Highland Rim, and the Central Till Plain**. Within these five natural regions, the Interstate crosses nine sections: **Driftless, Southern Bottomlands, Glaciated, Plainville Sand, Escarpment, Mitchell Karst Plain, Brown County Hills, and**

Tipton Till Plain (Figure 6). The following natural region section descriptions come from “The Natural Regions of Indiana,” by Homoya et al. (1985).

The **Southern Bottomlands Section** is the only section within the **Southern Bottomlands Natural Region**. Approximately 8% (11 miles) of the proposed Interstate crosses this section, primarily in Gibson and Pike counties. This natural region includes the alluvial bottomlands along rivers and larger streams of southwestern Indiana. The soils are mostly neutral to acid silt loams and much of the area is subject to frequent flooding. Natural communities of the region include bottomland forest, swamp, pond, slough, and former marsh and prairie. Bottomland forest, the major community type of this region, is characterized by pecan, sugarberry, swamp chestnut oak, pin oak, swamp white oak, red maple, silver maple, honey locust, catalpa, shellbark hickory, sycamore, and green ash. Swamp and slough communities are characterized by bald cypress, swamp cottonwood, water locust, pumpkin ash, and overcup oak. Other distinctive species (many of which are restricted to this region) include American featherfoil, bloodleaf, acanthus, climbing dogbane, catbird grape, woolly pipe-vine, swamp privet, American snowbell, climbing hempweed, spiderlily, mistletoe, and giant cane. Distinctive southern animals include cottonmouth, hieroglyphic turtle, diamondbacked watersnake, eastern mud turtle, northern copperbelly, swamp rabbit, mosquitofish, harlequin darter, and yellow-crowned night heron.

The **Southwestern Lowlands Region** includes the **Driftless Section**, the **Glaciated Section**, and the **Plainville Sand Section**. The Southwestern Lowlands Region is characterized by low relief and extensive aggraded valleys. This region, except for the southern portion, was covered by the Illinoian Glacier. Much of the region is nearly level, undissected, and poorly drained, although in some areas the topography is hilly and well drained.

Approximately 12% (17.5 miles) of the proposed Interstate is within the **Driftless Section**, primarily in Gibson and Pike counties. This section is south of the Illinoian glacial border, and is characterized by low hills and broad valleys. This area has the longest growing season and highest average summer temperature in the state. Natural communities include upland forest, occupying the well-drained slopes, and southern flatwoods occupying lacustrine plains and river terraces. Flatwoods species include cherry bark oak, sweetgum, shellbark hickory, pin oak, swamp white oak, Shumard’s oak, green ash, black gum, and locally, post oak. Upland forests of this section are relatively dry communities dominated by oaks and hickories. Other natural communities include marsh, swamp, sandstone cliff, and low to medium-gradient stream. Soils in this section are predominately acidic.

The **Glaciated Section** is also part of the Southwestern Bottomlands Region. Approximately 24% (34 miles) of the alternative passes through this section, in portions of Pike, Daviess, and Greene counties. Natural communities in this section are mostly forests, but several types of former prairie are known. The flatwoods community is common, but species composition differs from the Driftless Section. Common flatwoods species in this section include shagbark hickory, shellbark hickory, pin oak, shingle oak, hackberry, green ash, red maple, and silver maple. Black ash swamps are near their southern limit in this section. This section also appears to have the largest amount of prairie south of the Wisconsin glacial border in Indiana; however, little is known about the composition of this prairie. Additional community types include: swamp,

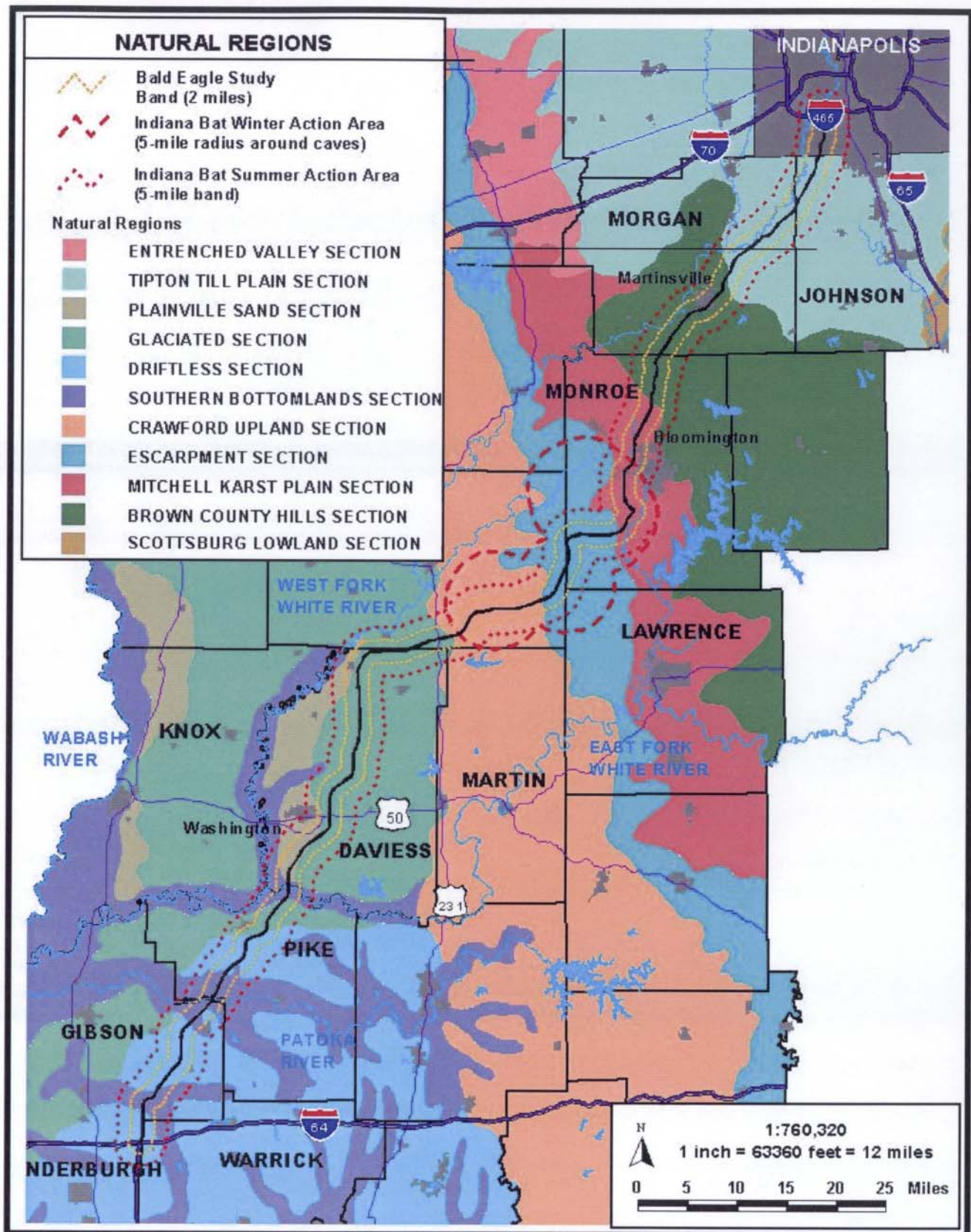


Figure 6. Natural regions (Homoya et al. 1985), species Action Areas, and proposed I-69.

marsh, pond, and low-gradient stream. The prairie kingsnake and the crawfish frog are characteristic animal species of this region.

Approximately 4% (5 miles) of the proposed Interstate traverses the **Plainville Sand Section** in Daviess County, also in the Southwestern Bottomlands Region. This section is a small, but unique, area of wind-blown sand dunes east of the Wabash and White Rivers. Soils are sandy and acidic. The barrens natural community, now almost gone from the landscape, predominated on the ridges and well-drained areas, and swamp, marsh, and wet prairie occupied the swales. The barrens vegetation consisted mostly of prairie species, along with some western and southern sand-dwelling species, including beard grass, Carolina anemone, tube penstemon, clustered poppy-mallow, hairy golden aster, narrowleaf dayflower, black hickory, adrosace, rose gentian, sedge, and fleabane. In a few areas, barren vegetation, including little bluestem, big bluestem, Indian grass, side-oats grama, New Jersey tea, and blackjack oak, can still be seen. Animal species restricted to the geographic area include the bull snake, ornate box turtle, and six-lined racerunner.

The **Shawnee Hills Natural Region** includes the **Crawford Upland Section** and the **Escarpment Section**. This natural region appears to represent general presettlement conditions better than any other terrestrial region in the state. It is a rugged and generally sparsely populated area. Most natural communities are upland forest, although a few sandstone and limestone glades, gravel washes, and barrens are known.

Approximately 7% (10.5 miles) of the preferred alternative is within the **Crawford Upland Section**, in Greene County. This section of the Shawnee Hills Natural Region contains rugged hills with sandstone cliffs and rockhouses. The soils are characteristically well drained acid silt loams. Forest vegetation consists of an oak-hickory assortment on upper slopes, while coves have a mesic component. Characteristic upper slope species include black oak, white oak, chestnut oak, scarlet oak, post oak, pignut hickory, small-fruited hickory, shagbark hickory, and rarely, sourwood. Characteristic species of cove forests include beech, tulip tree, red oak, sugar maple, black walnut, white ash, and locally, yellow buckeye, white basswood, hemlock, yellow birch, and umbrella magnolia. The sandstone cliff and rockhouse communities provide environments for several species with Appalachian affinities, including mountain laurel, mountain spleenwort, sourwood, and umbrella magnolia. Distinctive species associated with rockhouses include filmy fern, alumroot, Bradley's spleenwort, French's shooting star, and the Appalachian gametophyte. There are a few spring communities, a type extremely rare in Indiana. Vegetation characteristic of these communities include cinnamon fern, royal fern, sedges, small clubspur orchid, black chokeberry, winterberry, tearthumb, jewelweed, crested wood fern, and *Sphagnum* spp. The barrens community is, and probably was, a minor component of this section, and only a few remnants remain. Sandstone glades are very rare in Indiana, but at least two are known in this section. Characteristic species in sandstone glades include: bluestem, slender knotweed, poverty grass, farkleberry, goat's rue, pinweed, pinweed, and panic grass. Two interesting mammals in this section are the smoky and pygmy shrews.

Approximately 9% (12 miles) of the proposed Interstate crosses the **Escarpment Section** of the Shawnee Hills Natural Region in portions of Greene and Monroe counties. This section includes rugged hills along the eastern border of the region. Sandstone and sandstone- derived soils are

found on hill tops, and limestone and limestone-derived soils are present at lower elevations. Karst features are common, especially in the lower and middle elevations. Natural communities in this section consist of various upland forest types, especially dry-mesic and mesic. Species composition is similar to the Crawford Upland Section, except certain species, such as post oak and black oak, commonly replace chestnut oak on dry sites; and some of the mesic cove species, especially those with Appalachian affinities, are absent. Limestone glades and barrens occur in this section, but are more common in the Highland Rim Natural Region. Limestone cliff communities occur at the southern end of this section. Rare species such as alumroot, wall-rue spleenwort, cleft phlox, wild liveforever, and black-seeded sedge can be found in the limestone cliffs. Eastern woodrats live in the crevices of cliffs along the Ohio River, which is also a roosting site for the black vulture. Caves are also common. They support unique animal species such as the troglobitic crayfish and northern cavefish. Some caves support populations of hibernating bats, including the federal and state endangered Indiana bat. Limestone gravel wash communities are found in this section, and the wild blue indigo is apparently confined in Indiana to these communities. Typical aquatic features include normally clear, medium and high-gradient streams, springs, and sinkhole ponds.

The **Highland Rim Natural Region** within the study area includes the **Mitchell Karst Plain Section** and the **Brown County Hills Section**. This natural region is unglaciated, except relatively unmodified glaciated areas at the northern and eastern boundaries. A distinctive feature of this region is the large expanse of karst topography, although several other major topographical features are also present, such as cliffs and rugged hills. Much of the area was forested in presettlement times, but large barrens, small glades (limestone and siltstone), and gravel wash communities also occurred.

Approximately 11% (15 miles) of the proposed Interstate crosses the **Mitchell Karst Plain Section** of the Highland Rim Natural Region, in Monroe County. The major feature of this section is the karst (sinkhole) plain. Several natural community types are associated with this plain, including caves, sinkhole ponds and swamps, flatwoods, barrens, limestone glades, and several upland forest types. The plain is relatively level, although in some areas, especially near the section's periphery, limestone cliffs and rugged hills are present. Caves are common. The soils are generally well drained silty loams derived from loess and weathered limestone. Possibly the largest area of barrens in Indiana was located in this section. Species commonly found in remnants of this prairie-like community include Indian grass, big bluestem, little bluestem, rattlesnake master, prairie dock, hairy sunflower, prairie willow, clasping milkweed, and *Carex meadii*. Most of Indiana's limestone glades occur in this region, although most are in counties outside the study area. This bedrock community has a prairie flora with additional distinctive species, including downy milk pea, angle-pod, axe-shaped St. John's wort, adder's tongue fern, crested coral root, orchid, and heartleaf Alexander. Gravel wash communities of limestone and chert border most streams. Characteristic species in these communities include big bluestem, Indian grass, Carolina willow, water willow, ninebark, pale dogwood, and bulrush. Karst wetland communities are the major aquatic feature of this section. Southern swamp species are known from some sinkhole swamps, including beakrush, log sedge, giant sedge, Virginia willow, small buttercup, and netted chain fern. Common dominants of these swamps are swamp cottonwood, pin oak, swamp white oak, red maple, and sweetgum. Sinkhole pond communities normally have open water and marshy borders with cattails, bulrush, bur-reed,

spatterdock, buttonbush, swamp loosestrife, bladderwort, and *Carex comosa*. Several forest communities are also present in this section, but the western mesophytic forest type is most common. Species characteristic of this forest type include white oak, sugar maple, shagbark hickory, pignut hickory, and white ash. Near glade communities some xeric forest are characterized by post oak, chinquapin oak, and blue ash. In karst areas, surface streams are few, as most of the drainage is underground.

Approximately 11% (16 miles) of the proposed Interstate traverses the **Brown County Hills Section**, in Monroe and Morgan counties. It is the second section in the study area in the Highland Rim Natural Region. This section is characterized by deeply dissected uplands, underlain by siltstone, shale, and sandstone. The soils are well drained acid silt loams with minor amounts of loess. Bedrock is near the surface, but rarely crops out. Natural communities are rather uniform in composition, with uplands dominated by oak-hickory, especially chestnut oak, and ravines with mesic species, such as beech, red oak, sugar maple, and white ash. The yellowwood tree is known in Indiana, but only from a small area in this section. Small, high-gradient, ephemeral streams are common, and larger streams are usually medium to low-gradient.

Finally, the **Central Till Plain Natural Region** is the fifth natural region that comprises the I-69 study area. This region includes the **Entrenched Valley Section** and the **Tipton Till Plain Section**. The Central Till Plain Natural Region is the largest natural region in Indiana, and is a formerly forested plain of the Wisconsin till in the central portion of the state. With the exception of the Entrenched Valley Section, the topography is homogenous, although glacial features such as moraines are common. The proposed Interstate does not pass through the Entrenched Valley Section, therefore it is not discussed further.

Approximately 14% (19 miles) of the proposed Interstate crosses the **Tipton Till Plain Section**, in portions of Morgan, Johnson, and Marion counties. This section is a mostly undissected plain formerly covered by an extensive beech-maple-oak forest. The soils are predominantly neutral silt and silty clay loams. The northern flatwoods community associated with these poorly drained soils was ubiquitous but now is confined to scattered woodlots. Species common within the community include red maple, pin oak, bur oak, swamp white oak, Shumard's oak, American elm, and green ash. In slightly better drained sites, characteristic species include beech, sugar maple, black maple, white oak, red oak, shagbark hickory, tulip poplar, red elm, basswood, and white ash. Other community types of this section include bog, prairie, marsh, seep, spring, and pond.

Major Drainages

Three major rivers are crossed by the 3C corridor: the East Fork of the White River, the Patoka River, and Pigeon Creek. The East Fork of the White River is the largest river that would be crossed between Evansville and Indianapolis. It is a slow-moving stream that drains approximately 5,700 square miles. The proposed location for the I-69 bridge is approximately 1.5 miles east or upstream of the existing SR 57 bridge, which spans the East Fork between Pike and Daviess counties. The Patoka River is approximately 100 miles long with an 860 square mile drainage basin. The proposed crossing of this river is within the acquisition boundary of the Patoka River National Wildlife Refuge. Much of this river has been dredged and straightened;

however, the portion from about US 41 to the Wabash River is still natural and meandering. Pigeon Creek is a low-gradient stream with turbid waters. The proposed bridge crossing for Pigeon Creek is in Gibson County. This creek is classified as a legal drain and has been dredged in places to channelize the stream. The Indiana Department of Environmental Management (IDEM) has listed the Patoka River, southern portion of Pigeon Creek, and portions of the East Fork of the White River on the 2002 303(d) List of Impaired Waterbodies. Parameters of concern for the Patoka include PCBs and mercury. Parameters for concern in Pigeon Creek include PCBs, sulfates, TDS, pathogens, and low dissolved oxygen. The parameter of concern for the East Fork of the White River upstream of the project area is PCBs.

Karst Features

Karst features are especially common in the Mitchell Plateau and Crawford Upland physiographic/natural regions. The portion of Alternative 3C in Monroe County, and to a lesser extent Greene County, crosses karst terrain. The term “karst” refers to “landscapes characterized by caves, sinkholes, underground streams, and other features formed by the slow dissolving, rather than the mechanical eroding of bedrock” (American Geological Institute 2001). Because the underlying bedrock is easily dissolved by water, there is often a direct connection between surface and ground water. Little water purification occurs because the water flows directly through cracks and fissures rather than percolating slowly through the ground as in other types of terrain. Therefore, ground water resources are especially susceptible to degradation from pollution in karst areas. Pollution from both urban (e.g., untreated stormwater runoff, point-source dischargers/NPDES permits) and rural sources (e.g., residential septic systems, livestock waste, and agricultural pesticides) is an important concern in karst areas.

Caves often contain highly specialized ecosystems with distinct microclimates. Caves are not exposed to sunlight and the temperature of the cave varies due to air movement near the entrances, the location (on ridges or in valleys), and the temperature of water entering the cave. Aquatic species that live in caves and karst terrain are especially sensitive to pollution because it is easily introduced to their environment via water flow with little filtering or dilution. However other species such as bats that only use caves during part of their life cycle (i.e., winter hibernation) also may be adversely affected by pollution entering caves or changes to a cave’s hydrology or temperature regime.

Karst habitat is a non-renewable resource that is biologically important because it provides habitat for a number of rare, threatened, and endangered species that depend on caves to different degrees. Troglobites are animals highly adapted to complete their entire life cycle in cave environments. Troglobitic species often include flatworms, isopods, amphipods, eyeless cave shrimp, cave crayfish, bristletails, eyeless cave fish, and cave beetles. Because food in caves is scarce, full time cave dwellers tend to be smaller, with lower metabolism and longer life spans than their surface counterparts. Troglaphiles pass their life cycle within caves when sufficient food is present, or in dark, cool, moist environments just outside the cave. Examples of troglaphiles include segmented worms, snails, copepods, spiders, salamanders, springfish, phalangids, mites, pseudoscorpions, millipedes, and cave crickets (*Hadenoeus*). Troglaxenes are species that use caves, but cannot complete their life cycles within them. Crickets, bats, pack rats, flies and gnats are troglaxenes. Many species of bats, including the Federally endangered Indiana bat, use caves in karst areas within the Winter Action Area of I-69. By collecting food

on the surface and then returning to caves, troglomenes play an important role in providing food (e.g., fecal matter) for cave animals that never venture outside. The life histories of all cave animals highlight the fragility and interconnectedness of the surface and the cave environments (NSS 2003).

Even though the Monroe County has some of the largest karst areas in Indiana, the diversity of troglobitic species in its numerous caves have yet to be well surveyed for karst invertebrates (pers. comm. with Dr. Julian Lewis). Because karst invertebrates often have a high rate of endemism it is generally safe to assume that some unknown number of species that are new to science exist in the karst areas that will be directly or indirectly impacted by Alternative 3C of I-69. According to data provided to INDOT from the Indiana Geological Survey, at least 12 cave entrances are known to be located within the 2000-foot corridor for Alternative 3C.

General Habitat Conditions

According to the Tier 1 BA for I-69, FHWA and INDOT estimate that Alternative 3C will directly impact approximately 1062 acres of upland and bottomland forest (i.e., non-wetland forest) and approximately 75 acres of wetlands. Because no field studies were conducted during the Tier 1 phase of this project, we have no information regarding the quality or general condition of the forest or wetlands that will be impacted. Nevertheless, the following generic description of the existing habitat is believed to be representative of much of the project area.

The native forest communities that once dominated southwestern Indiana are now largely confined to scattered woodlots; much of the area has been converted to agricultural land uses. Within the species action areas, agriculture, residential and commercial development, and transportation infrastructure have resulted in extensive clearing and construction. Agriculture and forest land uses dominant much of the landscape. In addition, remaining natural habitats (e.g., forests and wetlands) and previously converted agricultural lands are now widely being converted for commercial and residential developments. Vegetation adjacent to most streams and tributaries that will be crossed by I-69 includes row crops, pasture, old fields, and patches of riparian forest. Within the northern and southern ends of project area, much of the highest quality wildlife habitat is associated with stream corridors and associated strips and small blocks of riparian forests. In addition to riparian forest vegetation, isolated woodlots also occur within the project area and a few larger areas managed forest habitat (e.g., Morgan Monroe State Forest, Crane Naval Surface Warfare Center). Some grassy and brushy areas with widely scattered mature trees and tree-lined fencerows also provide limited wildlife habitat.

Indiana Bats within the Action Area

No previous section 7 formal consultations involving Indiana bats have been conducted within the boundaries of the Indiana Summer or Winter Action Areas established for Alternative 3C of I-69. However, numerous informal and a few formal consultations have occurred for this species within some of the same counties that will be traversed or in similar habitat located elsewhere within southern Indiana. The Indiana Natural Heritage Database (July 2003), maintained by the Indiana Department of Natural Resources (IDNR) Division of Nature Preserves, lists a total (hibernacula and summer roosts) of 57 recorded Indiana bat occurrences within southwestern Indiana. These occurrences range in time from 1896 to 2001, with a majority recorded after

1990. In general, more detailed information is known about Indiana bats within the Winter Action Area than the Summer Action Area.

Baseline for the Summer Action Area

Indiana bat summer habitat requirements are described in the **Life History** section of the biological opinion. Indiana bats are dependent on forested habitat during summer. During the night, they may travel up to 2.5 miles from their daytime roost tree while foraging on insects in forested areas and open areas adjacent to forests. For this reason, the Indiana bat Summer Action Area for I-69 extends for 2.5 miles in all directions from the edges of the 2000-foot 3C corridor (Figure 3).

Available Summer Habitat

INDOT's consultants, BLA, estimated the amount of forest landcover within the Summer Action Area using data derived from satellite images taken over 10 years ago (1992 LANDSAT images). While some new developments have certainly occurred within the Summer Action Area during the interim period, the Service believes these estimates do provide a rough indication of the quantity of forest habitat that may be currently available to bats for foraging and roosting during the summer. One drawback of these gross estimates is that they do not provide a clear indication of the degree of forest fragmentation that is present within the action area. The estimates for the entire Summer Action Area and for each of the six proposed project sections are presented in Table 8 of the Tier 1 BA and are hereby incorporated by reference.

According to Table 8 in the Tier 1 BA, the entire Summer Action Area encompasses a total of approximately 462,903 acres of which 142,039 acres or 31% is forested. Estimated forest cover within each project section are summarized in Table 4 and will serve as an approximate baseline of currently existing habitat available within the Summer Action Area.

Although no field surveys were completed in Tier 1 to determine whether Indiana bats are present, previous summer surveys have documented Indiana bats within or near the current Summer Action Area for the Alternative 3C corridor during the summer. Similarly, no qualitative assessments of the existing forests were attempted within the Alternative 3C Summer Action Area during Tier 1 studies. Therefore, the Service will use the forest data summarized in Table 4 as an approximate baseline of currently existing habitat available within the Summer Action Area, and give the benefit of the doubt to the Indiana bat by assuming that an unknown number of maternity colonies are present and that all of the forest habitat within the Summer Action Area, approximately 142,039 acres, is of high quality for roosting and foraging by Indiana bats. We believe this is a reasonable assumption given that the project is within the core maternity range of the species and that we know from personal observations that many patches of high quality habitat are scattered along the 3C corridor.

In 1993, Dr. John Whitaker, Jr., conducted mist net surveys for Indiana bats along INDOT's previously proposed Southwest Indiana Highway Corridor connecting I-64 to Bloomington, which basically followed the current Alternative 3C corridor of I-69. Although Dr. Whitaker surveyed areas he thought to have high quality summer habitat, he only captured Indiana bats at one of the 21 sites that was surveyed. That one site was located along the Patoka River near the proposed bridge crossing for I-69 and produced two lactating, female Indiana bats indicating a

Table. 4. Estimated amount of forest within the Summer Action Area of each Project Section of Alternative 3C of I-69.

Project Section Number	Total Acres within Summer Action Area	Total Forested Acres within Summer Action Area	Percent of the SAA within the Project Section that is Forested	Percent of Total Forest within each Project Section
1	45,985	8,000	17%	6%
2	89,912	17,642	20%	12%
3	80,972	8,611	11%	6%
4	85,755	54,018	63%	38%
5	71,523	33,680	47%	24%
6	88,346	19,974	23%	14%
Totals:	462,903	142,039	31%	100%

nursery colony was located nearby (Whitaker 1996). However, the number of bats that composed the Patoka River colony then and its current status now are unknown. Therefore, an unknown number of reproductive females use the Summer Action Area. Likewise, an unknown number of males and non-reproductive females also use the Action Area.

Additional records from southern Indiana can be used to gain a better understanding of the general distribution of Indiana bats across the I-69 study area. In 1996 and 1998 a total of five adult male Indiana bats were captured during mist net surveys of 41 sites in Jackson, Crawford, and Perry counties on the Brownstown and Tell City Ranger Districts of the Hoosier National Forest (HNF; U.S. Fish & Wildlife Service 1996, 3D/International 1998). Prior to these and other recent surveys in southern Indiana, it was known that adult male Indiana bats could often be found throughout southern Indiana in summer, but it was unclear if southern Indiana commonly supported maternity colonies of Indiana bats. Summer records of reproductive female or juvenile Indiana bats provide evidence of a nearby maternity colony. There are relatively few records of reproductive female Indiana bats or juveniles from the cave region of Indiana, during the summer (Brack 1983, Brack et al. 1987); however, the number of records is growing. For example, at Camp Atterbury, Johnson County, 2 reproductive female and 8 juvenile Indiana bats were captured during mist net surveys in the summer of 1997 and others were captured in 1999 (Montgomery Watson 1997 and 1999). At Jefferson Proving Ground, a closed Army ammunition testing facility in southern Indiana, 9 of 14 Indiana bats captured between 1993 and 1995 were adult females or juveniles (Pruitt 1995). Whitaker (1994) captured a lactating female Indiana bat in Jennings County. One reproductive female and five males were also captured at Crane Naval Surface Warfare Center in 1998 (BHE 1999). Tyrell and Brack (1990) reported that there are records for reproductive females or juveniles in Knox, Martin, and Ripley counties. Collectively, these records provide evidence that southern Indiana is clearly within the maternity range of the Indiana bat.

Based on the captures of reproductively active female Indiana bats along or near the Alternative 3C corridor and other recent evidence of male and female Indiana bat presence in southern Indiana, the Service concurs with the Tier I BA's conclusion that Indiana bats may be present in all forest habitat along the entire Alternative 3C corridor from Evansville to Indianapolis. Further the Service believes that based on the evidence provided here, the limited mist netting efforts conducted in many areas along the 3C corridor, and the large acreage of summer habitat that is

within the corridor, that multiple maternity colonies are likely to be present within or near the 3C corridor.

Other parameters that may affect the quality of the summer habitat within the action area is the size of existing forest tracts and the degree of forest fragmentation. Based on a thorough review of literature on Indiana bat summer habitat, Rommé et al. (1995) concluded that areas with less than 5% cover by deciduous forest will not support summering Indiana bats. Areas considered optimal are generally at least 30% forested. Forest cover within some portions of the 3C corridor already may be too low or too fragmented (e.g., portions of Marion, Johnson, Daviess and Gibson counties) to support maternity colonies. Of the currently known Indiana bat maternity colonies in Indiana, only one continues to persist within highly fragmented forest habitat near the Indianapolis International Airport in Marion and Hendricks counties and its remaining habitat has been augmented through extensive mitigation efforts to enhance habitat connectivity and quality.

The majority of the forested tracts within the Summer Action Area are privately owned. Some unknown number of Indiana bats occupying private forests is likely to be adversely affected by non-protective timber harvest methods or other activities conducted in a manner that degrades or destroys the suitability of the habitat for Indiana bats. Conversely, we are aware of some State-owned lands and private lands that are being managed in a manner that may be protective of Indiana bats. The Division of Forestry manages the Morgan-Monroe and Martin state forests, which both have parcels within the Summer Action Area. We assume bat-friendly habitat management also is occurring at the following areas (and will continue) within the Summer Action Area: Sugar Ridge Fish and Wildlife Area, Thousand-Acre Woods, Griffy Woods Nature Preserve, Bean Blossom Bottoms Nature Preserve, and Blue Bluff Nature Preserve.

Ongoing Threats

The Service believes the following State, local, and private actions are currently occurring within the Summer Action Area, are likely to be adversely affecting Indiana bats to some degree, and are likely to continue into the reasonably foreseeable future.

- Loss and degradation of roosting and foraging habitat – commercial and residential developments are converting, fragmenting, or otherwise degrading forest habitat available for roosting and foraging, especially near larger urban centers. Most of the forest within the Summer Action Area is privately owned by numerous individuals and entities and may be managed in a manner that degrades the quality or completely eliminates the habitat.
- Degraded water quality – Point and non-point source pollution from agricultural, commercial, and residential areas reduces aquatic insect biomass that form a portion of the Indiana bat prey base.
- Commercial and private timber harvesting –Because some large and small timber harvests occur within the Summer Action Area while bats are roosting in trees between 15 April and 15 September some unknown number may be directly killed or harmed as the trees are felled.

Baseline for the Winter Action Area

Indiana bat spring-staging, fall-swarming and winter hibernacula habitat requirements are described in the **Life History** section of the biological opinion. Detailed information about each hibernaculum in the Winter Action Area is contained in the Tier 1 BA and is hereby incorporated by reference. Indiana bats are dependent on caves (or underground mines) for hibernation during the winter and the forested habitat that surrounds them, which they use for foraging and roosting during the fall swarming and spring staging periods. The FHWA and INDOT did not conduct field surveys for Indiana bats at the numerous potential (undocumented) hibernacula (caves and mines) within 5-miles of the 3C corridor during the Tier 1 NEPA process, but they do plan to conduct such surveys during the Tier 2 studies of each project section.

Hibernating Population

Because Indiana bats form rather conspicuous clusters on cave ceilings while hibernating, bat biologists are able to obtain remarkably accurate estimates of winter populations within most hibernacula and thereby track population trends over time.

The 10 known Indiana bat hibernacula that are the basis of the Winter Action Area include eight caves in western Monroe County - Buckner, Coon, Grotto, King Blair/Brinegar, Leonard Springs, Reeve's, Salamander, and Saltpeter caves, and two caves in eastern Greene County - Sexton Spring Cave and Ashcraft Cave. The 10 known Indiana bat hibernacula located within the Winter Action Area sheltered a combined total hibernating population of 21,624 Indiana bats in 2003 (Brack et al. 2003, Andy King per. comm.). Therefore, the 2003 Winter Action Area population represented approximately 12% of all the Indiana bats hibernating within the State of Indiana in 2003 ($n = 183,332$) and nearly 6% of the range-wide population estimated to be 382,350 bats in 2001 (Brack et al. 2003, Clawson 2002, Andy King per. comm.). The Service considered the 2003 population data for each hibernaculum individually and collectively as the baseline for the Indiana bat population within the Winter Action Area. Population numbers and trends for individual caves within and near the Winter Action Area are available in Table 7 and Figures 19-21 of the Tier 1 BA.

Two of the hibernacula within the Winter Action Area, Coon and Grotto caves, have exhibited a dramatic increase in their hibernating populations of Indiana bats since detailed surveys have begun. In 1960, Coon Cave only had 9 Indiana bats and Grotto Cave had 200, but nearly each survey year since then, these two caves have shown steady population increases. Surprisingly, between the 2001 and 2003 winter surveys, these two caves nearly doubled their winter populations with Coon Cave going from 6,395 bats to 10,675, and Grotto Cave going from 5,419 bats to 10,338. With a combined population of 21,013 bats, Coon and Grotto caves sheltered 97% of the Indiana bats that hibernated within the Winter Action Area in 2003. Most of the other hibernacula within the Winter Action Area have remained relatively stable or experienced population declines in recent survey years.

Ray's Cave had the largest hibernating population of Indiana bats in the general vicinity of the 3C corridor with 50,941 bats in 2003. By counting the bats in Ray's Cave and those in the 10 hibernacula within the Winter Action Area, there was a total of 72,565 Indiana bats hibernating within 6 miles of the proposed Alternative 3C corridor in 2003, which is approximately 19% of the known range-wide population. It is not known how much, if any, inter-cave movement

occurs among the hibernacula in the Winter Action Area or between them and Ray's Cave within a single winter or between winters.

Winter populations of Indiana bats in the State of Indiana declined from 1981 (148,000) to a low of 99,202 in 1985 before reaching a record high of 185,899 bats in 1999 (Brack et al 2003). In 2001, the Indiana bat population wintering in Indiana was estimated at 173,076. Surveys of hibernacula in Indiana in 2003 revealed an increase of over 10,000 Indiana bats with a state-wide hibernating population total of 183,332 (Brack et al. 2003, Andy King per. comm.)

Five of the 10 Winter Action Area hibernacula are located with the Garrison Chapel Valley, which is a well known karst area containing many large caves and springs in western Monroe County. There are two Priority Two hibernacula (500<population<30000), Coon and Grotto caves, which are less than ½ mile apart (Dunlap 2001). The other three hibernacula, Buckner, King Blair/Brinegar, and Salamander caves, are Priority Three hibernacula with winter populations of less than 500 Indiana bats. In addition to its large Indiana bat population, Grotto Cave has the highest population of little brown bats (*Myotis lucifugus*) of any cave in Indiana (n = 2363 little brown bats in 2003; Brack et al. 2003). King Blair/Brinegar and Saltpeter caves seem to show similar trends with populations increasing in the 1990s and then showing quick declines in the late 1990s and 2000s. Buckner and Salamander show similar trends of sharp declines after the 1980s. Salamander Cave has shown little to no use in surveys since 1987. Most of the population declines in the Indiana bat hibernacula within the Winter Action Area are attributable to repeated human disturbances during the winter (Brack et al. 2003), but the sudden drop in Buckner Cave between 1987 and 1989 suggested a single significant disturbance (shotgun blast, entrance room campfire, etc) may have greatly reduced the hibernating population in this cave (Dunlap 2001).

Ashcraft, Leonard Spring, Reeve's Cave, and Sexton Spring caves are Priority Three hibernacula. Ashcraft Cave had a small population in the 1990s that declined to only 3 bats in 1999. Leonard Spring Cave and Sexton Spring Cave both seem to show trends of relatively stable populations, although Leonard Spring Cave showed a dramatic decline in 2001 and a recovery in 2003 surveys (Brack et al. 2003). Reeve's Cave was documented as a newly discovered hibernaculum containing 34 Indiana bats in March 2003 (Andy King per. comm.) and therefore no population trend is known for this cave. Although the entrance to Reeve's Cave is gated, the gate is not a bat-friendly design and may be lowering the cave's suitability as an Indiana bat hibernaculum. The gate's opening is much smaller than the original cave entrance and it appears to restrict the cave's potential air flow and may be causing flying bats to slow down while negotiating the gate and thus increasing their risk of predation by domestic cats and other animals (per. comm. with cave owner).

Available Swarming/Staging Habitat

INDOT's consultants, BLA, estimated the amount of forest landcover within a 5-mile radius of each of the 10 known Indiana bat hibernacula in the Winter Action Area and within the collective boundaries of the action area. Because these estimates were derived from satellite images taken over 10 years ago (1992 LANDSAT images) and some new developments are known to have occurred within the Winter Action Area during the interim period, the Service believes these estimates only provide a rough indication of the quantity of foraging and roosting

habitat that may be currently available to bats during the swarming and staging periods. Another drawback of these gross estimates is that they do not give us a clear indication of the degree of forest fragmentation that is present within the surrounding area. The estimates are presented in Table 9 of the Tier 1 BA and are hereby incorporated by reference. The total area within a circle with a 5-mile radius is equal to 50,240 acres. The estimates ranged from a low of 23,000 acres of forest around Saltpeter Cave to a high of 32,987 acres of forest around Sexton Spring Cave. Therefore, approximately 46% to 66% of the land within 5 miles of each cave was forested. The Collective Winter Action area encompasses 168,764 acres in western and southwestern Monroe, eastern Greene, southeastern Owen, and northwestern Lawrence counties (Figure 3) of which approximately 59% (99,502 acres) is forest.

The vast majority of the forested tracts within the Winter Action Area is privately owned and may be vulnerable to timber extraction or other activities that may degrade or destroy the suitability of the habitat for Indiana bats. At this time, we are aware of two large forested parcels totaling 543 acres that are providing high-quality swarming habitat to the bats hibernating in the caves in the Garrison Chapel Valley in Monroe County and will remain forested in perpetuity. One parcel is enrolled in the Federal Forest Legacy program and the other has been voluntarily placed under a conservation easement held by the Sycamore Land Trust.

To our knowledge, a minimum threshold or optimum amount of surrounding swarming/staging habitat has yet to be defined for Indiana bats. However, we assume that Indiana bats are more likely to have their foraging and roosting needs met if their hibernacula are immediately (the closer the better) surrounded by large, relatively undisturbed contiguous tracts of mature and overmature forest as opposed to being surrounded by only small, highly fragmented woodlots, interspersed with agricultural, commercial, and residential areas. Additional habitat parameters that may be more indicative of the swarming/staging habitat's quality and degree of connectivity will be investigated in Tier 2 studies.

Ongoing Threats

The Service believes the following State, local, and private actions are currently occurring within the Winter Action Area, are likely to be adversely affecting Indiana bats to some degree and are likely to continue into the reasonably foreseeable future.

- Repeated human disturbance of hibernating bats – primarily caused by local and regional recreational cavers, spelunkers, and vandals. Nine of the 10 hibernacula are privately owned caves, only Ashcraft Cave is on state-owned land. Coon and Grotto caves are being specifically managed to protect hibernating Indiana bats via a private lease held by the Indiana Karst Conservancy. Only Coon, Grotto, and Reeve's caves are gated or fenced to prevent unauthorized human visitation.
- Loss and degradation of swarming/staging habitat – commercial and residential development are increasingly encroaching upon the hibernacula to the west of Bloomington and are reducing the amount of forest cover available for roosting and foraging. The vast majority of the remaining forest within the Winter Action Area is privately owned by numerous individuals and entities and may be vulnerable to activities that may degrade or destroy the suitability of the habitat for Indiana bats.
- Degraded water quality – residential developments with septic systems introduce untreated residential sewage into underground streams that may flow through

hibernacula and eventually resurface at springs, reducing aquatic insects and a portion of the Indiana bat prey base.

- Commercial and private timber harvesting –Because some large and small timber harvests occur within 5-miles of hibernacula while bats are roosting in trees between 1 April and 15 November some unknown number may be directly taken as the trees are felled.

Bald Eagles in the Action Area

No previous section 7 formal consultations involving bald eagles have been conducted within the boundaries of the Bald Eagle Action Area established for Alternative 3C of I-69, however, the Service has conducted informal consultations in similar eagle habitat elsewhere in the state. Bald eagle habitat requirements are described in the **Life History** section of the biological opinion.

Most of the bald eagles nesting within Indiana today are the result of a successful eagle restoration project conducted from 1985 to 1989 by the Indiana DNR's Nongame and Endangered Wildlife Program. Over this five-year period, 73 bald eagle chicks were hatched and released at Monroe Reservoir in Monroe County. When the released eagles reached adulthood at four to five years of age, many returned to nest within 50-100 miles of where they had fledged. Most nests are located in south central Indiana and are found on larger reservoirs and along the Wabash and White River. Indiana's first successful bald eagle nest in this century was in 1991 at Lake Monroe. The state's last successful nest before then was in 1897. By that time Indiana had lost most of its once extensive wetland habitat and in the 1950's and 60's eagle populations decreased further as they failed to reproduce due to egg shell thinning caused by pesticides, such as DDT. As of March 2003, there were 37 reported bald eagle nests within the southwestern portion of the Indiana. Some of these nests may serve as winter use sites too. Twenty-three of the 37 nest sites were also used by eagles in 2002.

Midwinter bald eagle surveys conducted since 1979 have shown a dramatic increase in wintering eagles in the state. During the Midwinter Eagle Survey in January 2003, 145 bald eagles were counted, 29% below the count for 2002 and 48% fewer than the record of 280 in 2001. However, this is only 5% below the average of the past 10 years. The low number counted in 2003 is attributed to a lack of sustained cold weather prior to the survey, resulting in fewer numbers of eagles moving south (Castrale and Holbrook 2003). Bald eagle research in Indiana by the IDNR Non-game Wildlife Program is ongoing and includes winter surveys by helicopter, monitoring of bald eagle nests, and banding of young bald eagles.

Nesting and Wintering Areas within or near the Action Area

No known nests are currently located within the Bald Eagle Action Area. However, nests in two areas are less than a mile of the Action Area boundary.

1. The first nest is located on the West Fork of the White River near Waverly in Morgan County. This nest was first reported in 2002. If standard disturbance management zones are implemented around this nest (USFWS 1983a), the tertiary zone would likely overlap a portion of the Action Area's outer limit, which follows S.R. 37 in this project section.
2. The second nesting area is located near the South Fork of the Patoka River, east of the proposed I-69 bridge crossing in Gibson County. Two bald eagle nests are located in this

area and were first reported in 2001 and again in 2002, and 2003. The two nests are less than 1,500 feet from one another, and are assumed to be within the breeding area of a single pair of eagles. Both nests are on Federal land managed by the Service's Patoka River National Wildlife Refuge staff. The proposed 3C corridor is just over 1 mile from the tertiary zone boundaries of both nests or just outside of the Bald Eagle Action Area.

Although bald eagles could potentially nest in different forest, wetland or riparian areas within the Action Area, the most likely nesting areas are near the proposed crossings of the Patoka River and the East Fork of the White River and in the areas where 3C Corridor closely approaches the West Fork of the White River (project sections 2, 5, and 6; Figures 2 and 3). Likewise, most of the wintering bald eagles should be concentrated in these same areas.

No bald eagles nested near the proposed I-69 crossing of the East Fork of the White River in 2003. In 2002, the nearest reported nest on the East Fork was about 8 miles upstream from the proposed crossing. Also, there was a reported nest just over 10 miles west of the proposed crossing on the mainstem of the White River, downstream from the proposed I-69 crossing.

Ongoing Threats

The Service believes the following State, local, and private actions are likely to be occurring to some bald eagles or their habitat within or near the Bald Eagle Action Area, and that these activities may be adversely affecting them to some degree and are likely to continue into the reasonably foreseeable future.

- Disturbance of eagles while nesting, foraging, and perching/roosting – eagles are often disturbed visually and/or by loud noises from various sources such as motorized watercrafts, all-terrain vehicles, road traffic, farm machinery, chainsaws, and gunshots.
- Degradation of water quality/prey base - Point and non-point source pollution from things such as agricultural pesticides, soil erosion, road salt, livestock waste, and commercial, industrial, and residential wastes all reduce aquatic diversity and abundance including fish that form a large portion of the bald eagle's prey base.
- Loss of bottomland and riparian forest habitat –As a result of expanded agricultural, industrial, commercial, and residential developments and timber harvests within the floodplains of large rivers.

IV. EFFECTS OF THE ACTION

While analyzing direct and indirect effects of the proposed action, the Service considered the following factors:

- proximity of the action to known species locations and designated critical habitat,
- distribution of the disturbances and impacts (in this case a linear corridor),
- timing of the effects in relation to sensitive periods in the species' lifecycle,
- nature of the effects – how the effects of the action may be manifested in elements of a species' lifecycle, population size or variability, or distribution, and how individual animals may be affected,
- duration of effects - short-term, long-term, permanent,

- disturbance frequency - number of events per unit of time, and
- disturbance severity - how long would it take a population to recover?

Anticipated direct and indirect impacts and their effects on Indiana bats and bald eagles are outlined below. The outline is organized by species, direct vs. indirect impact/effect, phase of the project: construction, operation, or maintenance. The applicable time(s) of year are also indicated. After each adverse effect is a brief description of specific avoidance, minimization, and mitigation efforts that FHWA and INDOT have already taken or agreed to implement (or attempt to implement) in order to further reduce adverse effects and incidental take of Indiana bats and bald eagles within the action areas (these are shown in *italics*). The complete list of proposed avoidance and minimization measures is included in the “Conservation Measures for Impacts to Threatened and Endangered Species” subsection under the PROPOSED ACTION section above.

INDIANA BAT

Direct Effects

CONSTRUCTION

- Tree/Forest Clearing

SPRING/SUMMER/FALL

- Mortality/Injury/Harassment of roosting bats – removal of a roost tree while Indiana bats are present would likely result in directly killing, injuring, and/or harassing individuals or a colony.

FHWA/INDOT have agreed to abide by seasonal tree-cutting restriction by not clearing any trees greater than 3 inches in diameter when bats are likely to be present: between April 15 and September 15 within the Summer Action Area or between April 1 and November 15 within the Winter Action Area. Therefore, little or no direct take of Indiana bats is anticipated from tree clearing during construction (or maintenance) of I-69. Mist netting surveys and radio-tracking studies will be conducted in Tier 2 studies of each project section. When possible, site-specific measures will be developed in consultation with the Service to avoid removing any primary and alternate roost trees located during Tier 2 surveys.

- Permanent Loss of Roosting and Foraging Habitat – Rough estimates of direct loss of forest habitat were quantified in Table 8 (Summer Action Area) and Table 9 (Winter Action Area) in the Tier 1 BA and are presented below in this document as Tables 5 and 6. Acres of existing forest were estimated within each of the six Tier 2 project sections (approximately 5-miles wide by variable length) and each circular areas around the 10 Indiana bat hibernacula (5-mile radius), then recalculated subtracting forest needing to be cleared within the proposed construction limits of the Tier 1 working alignment of 3C. Based on Tier 1 estimates, **a total of approximately 1299 acres of forest will be permanently lost from construction of Alternative 3C of I-69.** This only represents a loss of 0.91% of the existing forest within the entire Summer Action Area, losses within individual project sections would range from 0.15% (Project Section 6) to 1.8% (Project Section 4). Project Section 4 (between U.S. 231 and SR 37 in Bloomington) is the most heavily forested section of the

Table 5. Forest Landcover* in the Indiana Bat Summer Action Area for each Project Section before and after I-69 construction.

	Section 1			Section 2			Section 3		
	Section	After I-69**	Diff	Section	After I-69	Diff	Section	After I-69	Diff
Forest Area (ac)	8,000	7,986	14	17,642	17,519	123	8,611	8,574	37
Total Area (ac)	45,985	45,435	550	89,912	88,609	1,303	80,972	79,869	1,103
% Forest Loss			0.18			0.70			0.43
% Forested Action Area	17.39	17.37	N/A	19.62	19.48	N/A	10.63	10.59	N/A
% Forested Working Alignment:			2.54			9.44			3.35%

	Section 4			Section 5			Section 6		
	Section	After I-69	Diff	Section	After I-69	Diff	Section	After I-69	Diff
Forest Area (ac)	54,018	53,041.5	976.5	33,680	33,560.5	120	19,974	19,945	29
Total Area (ac)	85,755	84,193	1,562	71,523	70,941	582	88,346	87,743.5	602.5
% Forest Loss			1.80			0.70			0.15
% Forested Action Area	63.00	61.85	N/A	47.10	46.92	N/A	22.60	22.58	N/A
% Forested Working Alignment:			62.50			20.50			4.80%

Total Summer Action Area			Calculation Key		
Area	After I-69	Diff	Section	After I-69	Diff
Forest Area (ac)	142,039	140,740	A	C	A-C
Total Area (ac)	462,903	457,202	B	D	B-D
% Forest Loss					A-C/A
% Forested Action Area	31.68	30.40	A/B	C/B	
% Forested Working Alignment:					A-C/B-D
		22.78			

* Landcover was analyzed using a shapefile created from a smoothed USGS grid data interpreted from 1992 LANDSAT images with 30-m resolution.

** Calculations of Landcover After I-69 were done by subtracting the Tier 1 Working Alignment.

Table 6. Forest landcover* within 5 miles of known Indiana bat hibernacula in the Winter Action Area before and after I-69 construction.

	Ashcraft			Sexton Springs			Reeve's			Leonard Springs		
	5 mi r	After I-69**	Diff	5 mi r	After I-69	Diff	5 mi r	After I-69	Diff	5 mi r	After I-69	Diff
Forest Area (ac)	32,871	32,433	438	32,987	32,616	371	26,278	25,914	364	23,155.5	22,847	308.5
Total Area (ac)	50,240	49,685	575	50,240	49,647	593	50,240	49,549	691	50,240	49,648	592
% Forest Loss			1.33			1.12			1.39			0.38
% Forested Action Area	65.43	64.56	N/A	65.66	64.92	N/A	52.31	51.58	N/A	46.09	45.48	N/A
% Forested Working Alignment		76.00			62.60				52.70			52.10

	King Blair / Brinegar			Buckner's			Coon's			Grotto		
	5 mi r	After I-69	Diff	5 mi r	After I-69	Diff	5 mi r	After I-69	Diff	5 mi r	After I-69	Diff
Forest Area (ac)	28,977	28,671.5	305.5	28,455	28,185	270	28,610	28,498	112	26,916	26,828	88
Total Area (ac)	50,240	49,777	463	50,240	49,806.5	433.5	50,240	50,033	207	50,240	50,042	198
% Forest Loss			1.05			0.95			0.39			0.38
% Forested Action Area	57.68	57.07	N/A	56.64	56.10	N/A	56.95	56.72	N/A	53.57	53.40	N/A
% Forested Working Alignment		66.00			62.30				54.10			44.40

	Salamander			Salt Peter (Monroe)			Winter Action Area		
	5 mi r	After I-69	Diff	5 mi r	After I-69	Diff	5 mi r	After I-69	Diff
Forest Area (ac)	26,109	26,059	50	23,000	22,723	277	99,502	98,554	947
Total Area (ac)	50,240	50,080	160	50,240	49,680	560	168,764	167,203	1,561
% Forest Loss			0.19			0.20			0.35
% Forested Action Area	51.97	51.87	N/A	45.78	45.23	N/A	58.96	58.40	N/A
% Forested Working Alignment		31.25			49.50				60.70

* Landcover was analyzed using a shapefile created from a smoothed USGS grid data interpreted from 1992 LANDSAT images with 30-m resolution.

** Calculations of Landcover After I-69 were done by subtracting the Tier 1 Working Alignment.

project and would lose the most acres of forest (976.5 ac), which represents 1.8% of the existing forest within this section of the Summer Action Area. Comparisons of the percent of the working alignment forested to the percent of the landscape forested indicate successful forest avoidance in all sections with the exception of Section 4 where these percentages are very close. Because bats exhibit site fidelity to roosts and forage sites, potential exists, especially for pregnant females, to suffer stress searching for new roosting and foraging areas. It has been hypothesized that this stress could cause lower fat reserves and less successful reproduction and winter survival (USFWS 2002).

Based on Tier 1 estimates, **construction of I-69 would cause the permanent loss of approximately 947 acres of forest habitat within the Winter Action Area, which represents less than 1 percent (0.95%) of the 99,502 acres of currently existing forest in the area.** Collectively, 59% of the Winter Action Area is forested. The percentage of fall swarming/spring staging/forest habitat that would be lost around each hibernaculum ranges from 0.19% (50 acres) for Salamander Cave to 1.39% (364 acres) for Reeve's Cave. The three hibernacula that would loss the least percent of surrounding forest are Coon's (0.39%), Grotto (0.33%) and Salamander (0.19%) caves. Loss of forest habitat around a hibernaculum can result in a reduced capacity to support a local hibernating population.

When possible, FHWA/INDOT avoided forest and wetland areas when developing the working alignment of Alternative 3C. They have also agreed to mitigate for the permanent and unavoidable loss of forests (3:1 ratio) and wetlands (ratios in Table 2) within the action areas by purchasing existing habitat, and/or creating, restoring, and enhancing habitat. Based on Tier 1 estimates of impacts, the committed mitigation acreage would total approximately 4,089 acres (Table 2). In Tier 2, this number may change. The actual mitigation acres will be determined based on impact acres and the committed ratios which could provide higher or lower mitigation acres than the amount estimated in the Biological Assessment. All mitigation areas would be monitored for at least 5 years and permanently protected via conservation easements. Efforts will be made to mitigate in locations that will directly benefit individual bats likely to be impacted by the project. Specific sites will be finalized in consultation with the Service after Tier 2 surveys have revealed where important Indiana bat areas are located (e.g., maternity colonies, and new hibernacula). Opportunities will be investigated to benefit Indiana bats by purchasing additional summer/fall/spring forest habitat within the action areas from "willing-sellers" and turning it over to an appropriate government conservation and management agency for protection in perpetuity via conservation easements. Therefore, the adverse affects to Indiana bats within the action areas from the loss of summer/swarming/staging roosting and foraging habitat may be minimized. There is uncertainty as to what proportion of land owners with forested property within the action areas will be willing-sellers.

In addition, FHWA/INDOT have identified as potential mitigation sites two properties totaling 1,180 acres (approx. 740 acres of forest) located outside of the action areas. While valuable to the species, this "off-site" summer habitat (and potentially caves/winter hibernacula) is not likely to benefit Indiana bats within the I-69 action areas and therefore was only considered as a beneficial effect within the context of the Service's jeopardy analysis.

- Forest fragmentation - The 3C alignment will increase the degree of forest fragmentation by removing approximately 398 acres from core forests. Although only direct impacts

to core forest were estimated, it is expected that indirect impacts would also occur. The majority of core forest impacts will occur where there are large forested tracts of land, primarily in Greene and Monroe counties. Fragmentation of roosting and foraging habitat from tree clearing within the construction limits may degrade the remaining habitat's quality by reducing the size of and distance between remaining forest tracts and thereby lowering the overall amount of roosting and foraging habitat available to a maternity colony. In some areas where forest cover is already sparse, the percentage of remaining forest may fall below the minimum amount needed to sustain a colony.

While developing the 3C working alignment, FHWA/INDOT attempted to avoid forested areas especially large contiguous tracts of forest. The FHWA/INDOT will finalize their proposed forest mitigation plans in consultation with the Service, and specific attempts will be made to improve the connectivity between forest patches in areas known to be inhabited by Indiana bat maternity colonies discovered during Tier 2 surveys.

- Stream Relocation

- SPRING/SUMMER/FALL*

- According to the Tier 1 DEIS, up to 40 perennial streams and 80 intermittent streams will be crossed by the 3C alignment of I-69. Stream channel relocations will destroy any existing bat flyways, roosting, and foraging areas in the sections of streams being crossed, and lower the abundance of aquatic insects that form a portion of the Indiana bat's prey base.

FHWA/INDOT will develop site-specific mitigation and monitoring plans for stream relocations as appropriate. Proposed restoration actions will include the planting of woody and herbaceous vegetation to stabilize the banks and to provide future roosting and foraging habitat.

- Bridge Construction and Removal

- SPRING/SUMMER/FALL*

- Removal of an unknown number of concrete-girder bridges from existing roadways crossed by the proposed I-69 alignment could cause a loss of Indiana bat night roosts. Bats would have to expend energy to seek out other night roosts that may be less suitable or otherwise limited in a bat's range.

For bridges discovered to be night roosts during Tier 2 studies that need to be replaced, attempts will be made to replace them with bridges designed to create or recreate suitable night roosting areas.

- Construction of bridges spanning waterways could impact water quality, stream flow, and bank vegetation. This could lead to reduced aquatic insect production and degrade the quality of riparian foraging areas.

Impacts will be minimized by spanning as much of the floodplain as possible to preserve wildlife corridors and to minimize fill. FHWA/INDOT has committed to span the entire floodplain at the proposed crossing of the Patoka River.

- Water Quality Impacts

- YEAR ROUND*

- Spills of hazardous materials soil erosion could occur during construction and degrade the quality of both surface and ground water. Water quality affects the Indiana bat in

terms of its aquatic insect prey, drinking water, and the environment in hibernacula. The potential for adverse impacts may be highest within the 50 acres of sinkhole areas and sinking stream basins that would be traversed by the 3C alignment (Tier 1 DEIS, Table 6-1).

Impacts will be avoided or minimized by implementing equipment servicing and maintenance guidelines, contaminant spill, erosion-control, and herbicide use plans, following standard construction BMPs, and by installing filtering barriers in sinkhole areas (in accordance with the 1993 Karst MOU) and containment roadside ditches as appropriate.

- Blasting near Known Hibernacula

FALL/WINTER/SPRING

- Using explosives to blast through rock in karst areas can disturb or kill bats swarming, hibernating, or staging in nearby caves. Blasting too close to hibernacula may cause cave ceilings to collapse, which could directly kill hibernating bats or trap them inside. Blasting could also cause cave passages or sinkholes to become blocked, which could trap or possibly cause cave streams to backup and drown bats when present or exclude them from entering later. Blockages in a cave's passages or entries would also alter its airflow patterns and microclimates, which could make the cave unsuitable as an Indiana bat hibernaculum.

This potential impact will be avoided or minimized by determining safe blasting charges and distances in coordination with experts on a case by case basis, by following seasonal restrictions (i.e., when bats aren't hibernating), and by monitoring and surveying known hibernacula before and after blasting occurs.

- Destruction or Adverse Modification of Potential Hibernacula

FALL/WINTER/SPRING

- Because at least 11 caves are known to be within the 2000-foot corridor of 3C and some subset of 310 historic underground mines (mostly coal mines, the majority of which have been closed and are no longer accessible to bats) documented within 5 miles of the 3C working alignment may also be within the corridor, some potential exists for Indiana bats to hibernate within these caves/mines and others not yet known (if suitable) within the proposed construction limits of I-69. Construction activities (e.g., grading, filling, and blasting) could destroy or adversely modify these caves and mines and kill any bats present and would permanently render them inaccessible or otherwise unsuitable. Because cave systems are dynamic and change over time (e.g., passages enlarge through dissolution, new cave entries form from collapsed ceilings, etc.), some of the caves that may be directly impacted by I-69 that are not currently suitable as hibernacula could become suitable in the future. So, any actions that reduce the abundance of caves or permanently preclude their future use by Indiana bats could be considered an adverse affect. It should be noted that some caves may be suitable hibernacula, but are not currently used by Indiana bats because they have been repeatedly disturbed or vandalized by humans in the past.

Because caves are essentially a non-renewable resource, the FHWA/INDOT has shifted its working alignment to avoid direct impacts to known cave resources when possible and will continue to do so. During Tier 2, field surveys will be conducted to locate all cave entrances, sinkholes, and mines within the 2000-foot corridor. Any of these caves/mines or others deemed to be potential hibernacula that are within the Winter

Action Area or within 5 miles of the 3C corridor, will be surveyed for the presence of hibernating Indiana bats during Tier 2. Any newly discovered hibernacula will be avoided if at all possible and monitored throughout the project. Variable-width medians and/or independent alignments may be proposed to minimize direct impacts to hibernacula that can not be avoided.

FHWA and INDOT will investigate opportunities to purchase from “willing sellers”, an Indiana bat hibernaculum(a) including associated autumn swarming/spring staging habitat. After purchase and implementation of any needed management efforts, the hibernaculum(a) and associated buffer areas would be turned over to an appropriate government conservation and management agency for protection in perpetuity via conservation easements. Uncertainty remains as to what number of (if any) private property owners with land containing an Indiana bat hibernaculum(a) within the action areas will be willing to sell.

PROJECT OPERATION

- Increased Mortality from Vehicle / Bat Collisions

- SPRING/SUMMER/FALL*

- Although Indiana bats have been documented safely flying over busy interstate highways (e.g., I-70 near Indianapolis; USFWS 2002), the possibility exists for individuals to be directly killed by vehicles traveling on I-69 and associated roadways (e.g., overpasses and frontage roads) once they are operational. There have been recent studies investigating Indiana bats being killed by vehicle traffic on a 2-lane road near a maternity colony in Pennsylvania (Russell et al. 2002).

The Service anticipates that all bats that are struck by vehicles will be killed. The Service assumes that the annual number of deaths by vehicle collisions is not likely to exceed 10 Indiana bats. However, based on the best available scientific data, the actual number of Indiana bats that may be struck and killed from vehicles traveling on I-69 between Evansville and Indianapolis can not be precisely quantified during Tier 1. Therefore, this issue will be reexamined during each Tier 2 project-section consultations when more specific information will be available. For example, if a maternity colony or hibernaculum is located near I-69, additional studies may be undertaken to determine if and to what extent roadkill is occurring and FHWA/INDOT will consult with the Service to appropriately address the issue.

- Increased Disturbance from Light / Noise / Vibration

- YEAR ROUND*

- Increased light, traffic noise, and vibrations could cause disturbance to Indiana bats unaccustomed to these impacts while roosting, foraging, or hibernating nearby and thereby lower the suitability of adjacent habitats. Female bats in Illinois used roosts at least 1640 ft (500 m) from paved roadways (Garner and Gardener 1992). Very low bat usage close to Interstates has also been noted by other bat biologists (Whitaker, Jr. per. comm.). Conversely, some bats did use roosts near the I-70/Indianapolis Airport area, including a primary maternity roost 1970 ft (0.6 km) south of I-70. This roost was not abandoned despite constant noise from the Interstate and airport runways, however; their proximity to the Interstate could also have been due to lack of a more suitable roosting area (USFWS 2002).

No specific measures have been proposed to avoid, minimize, or mitigate these effects in Tier 1, but they may be developed in Tier 2 if evidence indicates they are warranted.

- Increased Public Awareness of Indiana Bats

YEAR ROUND

- Public awareness of Indiana bats, their life history requirements, and threats to the species is likely to increase as a direct result of educational pamphlets and interpretive displays that FHWA and INDOT have proposed to have designed and plan to distribute/display at public rest stops along I-69.

PROJECT MAINTENANCE

- Bridge Repair / Replacement

SPRING/SUMMER/FALL

- Night roosts could be destroyed, or degraded by repairs to concrete bridges or future replacement of concrete bridges with non-bat friendly designs. Bats using night roosts during maintenance projects would be forced to seek out other suitable night roosts that may be limited in number, of lower quality, or located further away.

INDOT maintenance staff will be made Aware of any bridges used as night roosts during Tier 2 studies and subsequently monitored in an effort to reduce unnecessary disturbances.

- Water Quality Impacts

YEAR ROUND

- Highway project maintenance could result in a spill of hazardous materials in wetland or karst areas. Spills could degrade quality of both surface and ground waters. Water quality affects the Indiana bat in terms of its aquatic insect prey, drinking water, and the environment in hibernacula. Impacts will be reduced or avoided by conservation measures.

Impacts will be reduced or avoided via proposed conservation measures.

INDIRECT EFFECTS

Indirect effects are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. Many of the indirect effects are beyond the authority of the FHWA or INDOT to control. Anticipated indirect effects include the following.

CONSTRUCTION, OPERATION, AND MAINTENANCE

- Habitat Loss and Degradation from Relocated and Induced Commercial and Residential

Development and other associated infrastructure (e.g., new roads, fire houses, and schools) is certain to occur along the new I-69, especially near proposed interchanges. According to the Tier 1 DEIS, from 28 to 31 interchanges are likely to be constructed or modified along the I-69 alignment. Induced development is also likely to occur in areas within and surrounding the cities being served by the interstate, especially the larger ones (e.g., Bloomington, Martinsville, Washington). Likewise, I-69 has been projected to stimulate new development at the Crane Naval Surface Warfare Center. According to the Tier 1 BA, FHWA and INDOT estimated that approximately 325 to 400 acres of forest and 10 to 30 acres of wetlands will be permanently cleared as part of development

that the Interstate will induce over time. According to the Tier 1 DEIS, up to 458 homes and 75 businesses may have to be relocated along the 3C corridor to make way for I-69. These relocations may lead to the removal of additional amount of forest and wetland habitat.

- Development will remove, degrade, and fragment forest serving as summer roosting and foraging and fall swarming/spring staging habitat.
- Runoff, erosion, and improper disposal of residential trash (e.g., dumping in sinkholes) resulting from induced development could degrade water quality and cave/hibernacula environments by altering karst hydrology (e.g., plug sinkhole drains).
- Use of pesticides, herbicides, and other chemicals at induced developments may affect bat habitat and prey base, and may bioaccumulate within the bats causing lethal or sublethal effects on individuals and reduce their reproduction.
- Water quality in surface and cave streams could also be degraded or threatened by improper sewage treatment (e.g., septic tanks in karst areas).

See efforts mentioned under Direct Effects of habitat loss above. FHWA and INDOT have made efforts to discourage adverse impacts to forest and karst features within the Winter Action Area by eliminating or minimizing interchanges near karst habitats (e.g., no interchanges are proposed in SW Monroe County).

- Utility Right-of-Ways (ROW) will need to be relocated/realigned to accommodate construction of I-69 and may potentially need to be expanded or added to accommodate newly induced development. This is likely to result in a permanent removal of some amount of Indiana bat foraging and roosting habitat. Depending on forest age classes and canopy cover, this could be beneficial by creating some openings and edge, or detrimental by fragmenting high quality habitat. Utility ROWs may also be maintained with herbicides that are toxic to aquatic life.
- Erosion and sedimentation from disturbed soil areas where induced development is occurring can degrade water quality and cave environments, as well as plug sinkhole drainages and cause flooding in karst areas, which could drown hibernating bats.
- Road Salt and Chemical Herbicides used to maintain the Interstate and may degrade surface and ground water through runoff and degrade cave environments. Some herbicides can affect bats by accumulating in their tissues as they consume contaminated insects or drinking contaminated water.

These impacts will be minimized by low-salt and no-spray strategies set forth in the Karst MOU (dated October 13, 1993) and the development of an Herbicide Use Plan.

- Contamination of Soil and Water from Vehicle Accidents - At some point during the operation of I-69, a vehicle accident(s) is likely to occur and result in a spill of hazardous materials into a stream, wetland or karst area. Spills could degrade quality of both surface and ground waters. Water quality affects the Indiana bat in terms of its aquatic insect prey, drinking water, and the environment in hibernacula.

Impacts will be reduced or avoided by emergency contaminant spill plans and filtering and containment roadside ditches placed in karst areas during construction in accordance with the multi-agency Karst MOU.

- Increased Human Disturbances to Hibernating Bats is possible at unprotected hibernacula within the Winter Action Area. Increased visitation at nearby caves may result once I-69 is operational because many more people and presumably more cavers/spelunkers would be within a shorter commuting distance/time than before.

Disturbance of hibernating bats at some currently unprotected hibernacula may be completely stopped or reduced by acquiring easements from cave owners to erect bat-friendly angle-iron gates. These gates restrict access to the caves preventing disturbance of hibernacula while maintaining airflow at the entrances and allowing bats to ingress and egress. If cave owners objected to installing a gate, then other structures (e.g., perimeter fencing) or techniques (e.g., alarm systems and signs) for discouraging unauthorized visitations would be investigated. Uncertainty remains as to what number of (if any) private property owners with land containing an Indiana bat hibernaculum(a) within the action area would be willing to allow FHWA/INDOT to install a gate or other deterrent.

- **Increased Predation of Bats by Domestic Cats.** – As yet another consequence of an increase in residential developments near hibernacula within the Winter Action Area, the resident population of free-ranging domestic and feral cats is likely to increase. More cats across the landscape may lead to higher predation rates on Indiana bats, especially as they enter and exit their hibernacula. Predation of bats by at least one domestic cat (a family pet) has been reported at the entrance of a gated Indiana bat hibernaculum near the owner's home (Reeve's Cave).

This effect will be minimized by attempting to replace any poorly designed bat gates that increase the potential for predation by cats or other wild animals (e.g., Reeve's Cave) and by monitoring other hibernacula where evidence suggests that predation by cats is occurring.

Discussion of Effects

Based on Tier 1 estimates, construction of I-69 along the proposed 3C alignment and its associated actions is expected to result in the permanent loss of approximately 1,137 acres of suitable summer foraging and roosting habitat for Indiana bats. This estimate includes 1,062 acres of upland and bottomland forest, 65 acres of forested wetlands, 5 acres of scrub-shrub wetlands, and 5 acres of emergent wetlands. In addition, approximately 400 acres of forest and 30 acres of wetlands will be permanently lost as part of development that the Interstate is expected to induce over time.

Therefore, **the total loss of forest habitat would be approximately 1,527 acres and the total loss of non-forested wetlands would be approximately 40 acres with a combined total of 1,567 acres of Indiana bat habitat.** Degradation of remaining habitat is also likely to occur as the result of increased fragmentation and increased disturbance. Associated effects are discussed in more detail below.

Evidence that a maternity colony existed in the I-69 Summer Action Area was first collected during bat surveys at the Patoka River in 1993, but the number of bats that composed that colony then and its current status now are unknown. Because the entire Evansville to Indianapolis corridor has yet to be surveyed for bats, and because the 1993 surveys are now outdated, we assume that additional maternity colonies may be present within the Summer Action Area. Therefore, an unknown number of reproductive females and their offspring use habitat within the Summer Action Area. Likewise, an unknown number of males and non-reproductive females also use the area.

A feature of Indiana bat biology that is integral to the discussion of effects of the proposed project is the fact that female Indiana bats exhibit strong site fidelity to summer roosting and foraging areas. That is, they return to the same summer range annually to bear their young. If the summer range is modified such that females are required to search for new roosting habitat or foraging areas, it is assumed that this effort places additional stress on pregnant females at a time when fat reserves are

low or depleted and they are already stressed from the energy demands of migration. This in turn could adversely affect the reproductive fitness and productivity of the bats.

Based on our knowledge of Indiana bat summer habitat use, and the specific information that has been collected on several colonies in Indiana, we assessed the impact of the loss and degradation of habitat in the Action Areas. We should note that there are many aspects of Indiana bat summer habitat that are not fully understood. The first maternity colony of Indiana bats was not discovered until 1971. This colony was discovered when a dead elm tree was bulldozed, and a colony of bats emerged from under the loose bark of the tree as it was pushed over. Several of the bats were captured, and subsequently identified as Indiana bats. Prior to this time, it was not known where female Indiana bats roosted and raised young. Since that time, considerable research has been done on Indiana bats during the summer, but many questions remain unanswered. Therefore, we cannot precisely predict how Indiana bats will be impacted by the proposed project. Our assessment is based on the best data that are available. We anticipate being able to conduct more precise effects analyses after Tier 2 studies are completed and when more site-specific information regarding the presence of any Indiana bat maternity colonies and the proximity of their roost trees to proposed impact areas is known.

Effects on Foraging Habitat

A primary effect of the proposed construction of I-69 on Indiana bats in the Summer Action Area will be the loss of foraging habitat. Based on Tier 1 estimates, 1,137 acres of forest and wetland habitat would be directly cleared; all of this land is assumed to be suitable Indiana bat foraging habitat. When Indiana bats return to their summer range, we expect that they will attempt to use the same foraging areas that were used in previous years. According to calculations in Table 8 of the Tier 1 BA, within the Summer Action Area, approximately 1,299 acres (less than 1%) of the 142,039 acres of forest habitat currently available will be gone after the clearing occurs for the proposed project. Bats that only foraged in the action area occasionally or along its periphery obviously are familiar with other foraging areas in addition to those within the Summer Action Area boundary. These bats may be able to adjust for lost habitat by spending more time foraging in other portions of their range. Conversely, for bats that traditionally have foraged extensively within the proposed I-69 construction zone in the center of the Summer Action Area, the effect will likely be more severe. These bats will still have some foraging habitat available within the Summer Action Area, but will likely have to expand their foraging range into previously unused areas to make up for the loss of foraging habitat. The impact of this on individual bats will vary. Recovery from the stress of hibernation and migration may be slower as the result of the added energy demands of searching for new foraging habitat; this may be particularly problematic for pregnant females. Pregnant females displaced from their preferred foraging range will have to expend energy to search for new areas; some may not be successful in producing young as the result. Females that do give live birth may have pups with lower birth weights or their pups may have delayed development. This could in turn affect the overwinter survival of the young-of-the-year bats if they enter fall migration and winter hibernation periods with inadequate fat reserves. Indiana bats may also experience higher rates of predation when searching for new foraging areas or while flying over areas cleared for I-69 to reach other foraging areas. Overall, the effect of the loss of foraging habitat on **individual** bats from the colony in the action area may range from no effect to death (e.g., as the result of exposure to predation or overwinter mortality of bats that have not stored adequate fat). The effect on a maternity colony may be lost reproductive capacity and death of some proportion of the individuals. These effects are expected to be relatively short-lived; bats that

survive the impacts of habitat loss will have found replacement foraging habitat within the second year after the habitat is lost within the Summer Action Area.

Effects on Roosting Habitat

Another primary effect on Indiana bats will be the loss of traditional roosting habitat as a result of the proposed project. While no maternity roost trees are currently known to be located within the proposed 3C corridor, some may be present and would be lost during construction or as induced development occurs. Our knowledge of the roosting behavior of any maternity colonies present in the Summer Action Area will be based on Tier 2 mist net surveys and the successful tracking of radio-tagged bats. Because only a small sample of Indiana bats would be tracked if captured, we cannot assume that all roost trees will be identified. It is safe to assume that there will be suitable roost trees within the construction limits, and it is plausible that some of these trees may be used as primary or alternate roosts by maternity colonies. Further, adult male and non-reproductive female Indiana bats are likely to use some roosts in the Summer Action Area. In summary, there is potential that currently used roosting habitat will be lost as the result of the proposed project. At a minimum, potential future roost trees will be lost as the result of the proposed activities. This will reduce the future number of suitable roosts within a colony's traditional summer range. Attempts will be made during Tier 2 studies to delineate the major roosting areas used by any colonies discovered along the 3C corridor. If primary and/or alternate maternity roosts are discovered within the proposed construction limits during Tier 2, they will not be cleared until after a site-specific effects analysis and reasonable avoidance, minimization, and mitigation efforts have been jointly developed and implemented in formal consultation with the Service.

Effects on Habitat Quality

In addition to direct habitat loss, proposed actions may result in a decrease in the quality of remaining habitat within the Action Areas. Factors that may lead to a loss in the quality of remaining habitat include: increased habitat fragmentation; increased human disturbance (e.g., more lighting associated with road improvements, increased traffic and associated noise); foraging habitat over culverted or relocated streams will be poor until the aquatic community becomes established; and water quality in the Action Areas may be negatively impacted, at least in the short term during construction activities, and potentially in the long-term from road salts, and various hazardous materials leaked during traffic accidents. Over time, it is expected that fragmentation of habitat in the Summer and Winter Action Areas will increase as new development occurs. However, as the mitigation plantings mature into suitable Indiana bat habitat this may be compensated. The majority of fragmentation to core forests will occur in the large forested tracts of land in Greene and Monroe counties.

Given the nature of the landscape in some portions of the Summer Action Area, there would be little potential for existing colonies to relocate if the quality or quantity of habitat in the area could no longer support the colony. The continued survival of a colony in this situation would likely dependent on maintaining suitable habitat within the action area of the project.

Increased human disturbance in the project area may affect the quality of summer bat habitat, but these effects are expected to be relatively minor. However, human disturbance within an unprotected Indiana bat hibernaculum could be severe. Some Indiana bats in the Action Areas that have not previously been exposed to artificial lighting, high noise levels and highway traffic may

avoid habitat near I-69, but this will probably only be a relatively minor adverse affect of the project.

Insects associated with aquatic habitats make up part of the diet of Indiana bats; therefore, water quality can affect the prey base of the species. Water quality impacts that may result from the proposed project include the relocation of stream channels, increased sedimentation as the result of construction activities, and increased runoff (and associated pollutants) from newly constructed roadways. All relocated stream channels will be planted with hardwood seedlings, which are expected to stabilize the banks; eventually trees are expected to provide shade to the riparian corridor, a source of woody debris to provide in-stream habitat, and Indiana bat foraging cover. Until these newly relocated channels become established, they will not provide foraging habitat for Indiana bats. Consultation with the FHWA and INDOT will be ongoing to insure that relocated stream channels produce viable aquatic systems. Aquatic communities will be monitored post-construction and remedial actions will be required if established criteria are not met. Erosion control plans will be implemented during all construction activities. Properly implemented erosion control measures should alleviate short-term sedimentation impacts on the aquatic insect community. We do not have information that suggests that these water quality impacts will result in a long-term decline in the prey base available to Indiana bats in the project area. However, a short-term decline in insect production is possible, and may exacerbate the issue of lost foraging habitat in the project area.

Effects of Avoidance, Minimization and Mitigation Measures

The FHWA and INDOT have incorporated measures into the proposed project design to avoid, minimize and mitigate the impacts of the project to the extent practical. Potential avoidance, minimization and mitigation procedures are discussed in the **Tier 1 Forest and Wetland Mitigation and Enhancement Plan** and **Conservation Measures** sections in this document and are further detailed in the Tier 1 BA.

To minimize impacts to bats due to habitat loss, existing forested habitat suitable for Indiana bat foraging, roosting, swarming, hibernating, and staging within the Summer and Winter Action Areas will be identified, and offers to purchase these areas will be made to the land owners, and bought when sellers are willing, and then they will be protected in perpetuity for the primary purpose of Indiana bat conservation. Silvicultural manipulation in these areas will be limited to activities which will enhance the quality of habitat for Indiana bats, as agreed on by the Service's BFO. Areas targeted for permanent protection will generally be of equal or higher quality (i.e., more mature trees) than many of areas that will be cleared for I-69. In addition, areas will specifically be sought that would provide larger forest blocks, and that would protect areas providing connectivity among existing blocks of forested habitat and other areas identified in Tier 2 studies as providing valuable habitat for Indiana bats or serving as travel corridors.

The FHWA and INDOT are proposing to mitigate for the permanent and unavoidable loss of forests (3:1 ratio) and wetlands (ratios in Table 2) within the action areas by purchasing existing habitat, and/or creating, restoring, and enhancing habitat. *Based on Tier 1 estimates of impacts, the committed mitigation acreage would total approximately 4,089 acres. In Tier 2, this number may change. The actual mitigation acres will be determined based on impact acres and the committed ratios which could provide higher or lower mitigation acres than the amount estimated in the Biological Assessment.* Some mitigation areas will be planted with a mixture of native hardwood seedlings and protected in

perpetuity. The goal of the plantings will be to enhance Indiana bat habitat in the long term by providing forested habitat, improving connectivity among blocks of existing habitat, and creating larger blocks of forested bat habitat. The specific sites proposed for plantings will also be located to improve the connectivity of forested habitat within the range of maternity colonies that would be adversely affected by I-69. Improved connectivity of habitat between roosting and foraging areas is expected to improve habitat conditions for Indiana bats. Permanently protected plantings along stream corridors will also benefit water quality in the long term, as the plantings will provide a vegetated buffer that will reduce runoff, and associated sedimentation, from adjoining roadways, commercial/industrial developments, and agricultural areas. In the long term, mitigation plantings will provide a diverse woodland that is well stocked with species of trees that are known to provide Indiana bat roosting habitat. Plantings will be monitored to insure that at least 80% of the initial planting survives; if survival is below 80% five years after planting, then remedial measures will be taken. There will be no manipulation of vegetation (e.g., mowing, timber stand improvement, firewood collecting) in these areas without consultation with the Service's BFO.

An extensive monitoring and research program is also proposed by the FHWA and INDOT. Therefore, any Indiana bat colonies discovered in the action area during Tier 2 field studies would be studied and monitored for at least 5 years post-construction, beginning with the first summer following the start of construction. The details of the proposed monitoring plan will be developed in consultation with the Service and finalized during Tier 2 formal consultations for each affected project section.

As previously noted, a colony of Indiana bats in the vicinity of the Indianapolis International Airport has been studied since 1994; this is the longest that any single colony of Indiana bats has ever been studied. The baseline data that are currently available on this colony, in conjunction with the data that is being collected through a 15-year monitoring program, will allow the Service to thoroughly evaluate the response of an Indiana bat colony to habitat disturbance from a major construction activity as well as the effectiveness of the mitigation measures implemented there. The Service will use information gained from the airport colony to help guide mitigation and monitoring efforts for any Indiana bat colonies found within the Summer Action Area of I-69.

The FHWA and INDOT will also work with the Service's BFO to design an educational brochure and interpretive displays about Indiana bats to be placed in rest stops along I-69. The Indiana bat recovery plan (USFWS 1983b) identifies public education on Indiana bats as a priority activity needed for recovery of the species.

Bald Eagle

Direct Impacts

CONSTRUCTION

- Tree Removal
 - Loss of forest habitat will occur within the Bald Eagle Action Area and may adversely affect some eagles. Although, all of the forest would not be preferred bald eagle habitat, some may be. Three relatively large rivers will either be crossed or approached by the proposed

Interstate, the Patoka River and the East and West Forks of the White River. Some tree clearing would occur during construction at the two river crossings. Construction of bridges at these locations will permanently remove some suitable habitat from future use.

Impacts will be reduced or avoided via proposed conservation measures.

- Known Bald Eagle Nests & Winter Use Sites in Relation to Direct Impacts
 - At this time, there are no known, recorded bald eagle nests within the Bald Eagle Action Area for the proposed project.
 - There are two nests along the South Fork of the Patoka River, near the proposed crossing of the Patoka River. Both nests are most likely within the same breeding area of a single pair of eagles. The nests are on property owned by the Patoka River National Wildlife Refuge. The tertiary zone boundaries for both nests are over 1 mile from the proposed corridor and outside the Action Area for the proposed project.
 - There are no nests near the proposed crossing of the East Fork of the White River. The closest nest is approximately 8 miles upstream. The East Fork of the White River in Daviess County is surveyed as part of the IDNR Midwinter Bald Eagle Survey. This area appears to be a relatively unimportant wintering site, with a 10-year average of only 0.6 eagles.
- There are no expected direct effects from construction to individual bald eagle use areas as part of the proposed project. However, updated records checks and bald eagle surveys will be completed as part of Tier 2 studies. If a bald eagle nest or its associated management zones, or a winter use site are found within the corridor at a later time, individuals of the species could be affected by the proposed project.

OPERATION

- Interstate Traffic
YEAR ROUND
 - Project operation could cause some number of bald eagle mortalities from vehicular collisions, especially in winter when food is scarce and bald eagles scavenge carrion on roadways. However, it is not anticipated this will be a severe impacts or negatively affect the population of this species. Risks of vehicular collision are influenced by the roadside landcover (forested corridors present higher risk due to limiting avoidance movements) and no bald eagle killed by a vehicle has been reported to INDOT along Indiana Interstates although isolated instances have occurred in the Toll Road District in northern Indiana.
 - Also, increased highway noise and lights, particularly near the crossings of the East Fork of the White River and the Patoka River area, could deter bald eagles from nesting in otherwise appropriate habitat near those areas.
- Increased Public Awareness of Bald Eagles
YEAR ROUND
 - Public awareness of bald eagles, their life history requirements, and threats to the species is likely to increase as a direct result of educational pamphlets and interpretive displays that FHWA and INDOT have proposed to have designed and plan to distribute/display at public rest stops along I-69.

Indirect Effects

CONSTRUCTION, OPERATION, AND MAINTENANCE

- Induced Commercial and Residential Development
 - Development will occur as a result of the proposed Interstate. It is estimated that approximately 325 - 400 acres of forest and 10 - 30 acres of wetlands will be permanently lost to development that the Interstate will bring. Much of this will not occur in preferred bald eagle habitat, but a small portion may. At this time, it is difficult to estimate the amount of preferred bald eagle habitat that could be lost.
 - Development may result in water quality issues such as erosion, sedimentation, or contamination from pesticides, improperly treated sewage, or other accidental chemical spills all of which could lower the abundance and diversity of fish that bald eagles prey on.
 - Development may bring new utilities and associated power lines. This could potentially increase bald eagle mortalities from electrocution and tower collisions.
 - Increased access to Lake Monroe has the possibility of increasing recreation that could result in more disturbance to eagles using the area.
If sufficient evidence warrants, recreational use and disturbance to eagles may be investigated further in Tier 2 studies.

- Water Quality
 - Erosion and sedimentation from areas of disturbed soil can degrade water quality, adversely affecting fish bald eagles feed upon. Servicing construction vehicles could cause an accidental chemical spill, and adversely affect water quality. Fugitive dust emissions could adversely affect area quality in the area of construction.
 - Highway accidents could result in a spill of hazardous materials into wetlands, or rivers/streams. Spills could be detrimental to the overall water quality, and in turn adversely affect fish the bald eagle feeds upon.
 - Road runoff may contain salts and chemicals that could degrade water quality and adversely affect the bald eagle food source.
 - Herbicides used in right-of-way and median areas could be ingested by bald eagle prey (fish) and bioaccumulate within the bald eagle.

Impacts will be avoided or minimized by implementing equipment servicing and maintenance guidelines, contaminant spill, erosion-control, and herbicide use plans, following standard construction BMPs, and by installing containment roadside ditches as appropriate.

Discussion of Effects

Based on information to date, a potential adverse affect from this project to individual bald eagles is the risk of death from vehicle collisions during project operation. This risk is influenced by roadside landcover, where forested road corridors pose a greater risk for collisions by limiting an eagle on the roadway to only vertical avoidance movements. Open roadsides better enable eagles to avoid oncoming vehicles by moving horizontally out of the path. To date, no bald eagle has been reported as killed by a vehicle on an Indiana Interstate (other than the Toll Road or I-80/I-90 located in the extreme northeast corner of Indiana). Nonetheless, several have been found along the eastern end of the Toll Road District (INDOT – Chief of Operations Support). Another possible affect from project operation includes risk of water quality degradation from hazardous spills and maintenance chemicals. Water quality directly affects fish, the species' primary food source.

There are no reported bald eagle nests within the Action Area (1 mile on either side of the proposed corridor) of the project. Also, no primary, secondary, or tertiary buffer zones, as detailed in the Northern States Bald Eagle Recovery Plan (1983a), or any reported bald eagle nests intersect the proposed 2000-foot corridor. The Action Area is double the distance of the standard tertiary buffer zone. There are currently three bald eagle nests (two within the breeding area of a single pair of eagles) just over 1 mile from the proposed corridor, one on the West Fork of the White River near Waverly in Morgan County and two along the South Fork of the Patoka River near the proposed crossing of the Patoka River. Construction of the proposed Interstate will be outside any recommended buffer zones needed to be protective of these nests.

Although the USFWS has proposed to delist the bald eagle from the threatened and endangered species list, habitat loss continues to be a concern for the species. The bald eagle will almost exclusively nest near relatively large, open water. Two areas that fit the description of preferred bald eagle habitat will be crossed by the proposed Interstate, the Patoka River bottoms area and the East Fork of the White River. Construction of the bridge at these locations, as well as the disturbance from light and noise from highway use may deter bald eagles from nesting in nearby areas. However, some bald eagles are tolerant of human disturbance, depending on the individual eagles as well as the time of year. The loss of habitat associated with the construction of the proposed bridge crossings will be minimal and is not likely to adversely affect bald eagles.

FHWA and INDOT will conduct additional, more detailed studies during Tier 2. Section 7 consultation will be conducted for each of the six project sections as part of Tier 2 studies. Bald eagle surveys within the action area will be conducted as part of these studies. If bald eagle nests are found within the action area during the surveys, the projects effects will be reassessed and reflected in a Tier 2 Biological Assessment.

V. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered because they require separate consultation pursuant to section 7 of the Endangered Species Act.

Cumulative Effects within the Indiana Bat Action Areas

Reasonably foreseeable non-federal activities that are anticipated to occur within both the Summer and Winter Action Areas for the Indiana bat are timber harvest and planned development for residential subdivisions. Various departments and individuals were contacted for such information. They included contacting the surveyor's office, recorder's office, auditor's office, highway superintendents, county and planning officials.

Timbering data was first requested from the Division of Forestry of the Indiana Department of Natural Resources. Discussions showed that there was no organized method of tracking timbering in any of the counties except possibly Monroe County. The Planning Department of Monroe

County disclosed that permits were sporadic and voluntary, and much of the timbering goes undocumented. Thus, field surveys from the mid-1990's to the present were reviewed for a general understanding of timbering activities in the Action Areas. Within the Action Areas, the majority of forests are found in the Crawford Upland, Mitchell Plain, Norman Upland, and Martinsville Hill physiographic regions. These regions include for the most part Greene, Monroe and Morgan counties.

Timbering is limited and sporadic in the Action Areas. Observations throughout many years indicate that cutting is for the most part selective and that much of the timber in the area is second growth indicating past activities. Classified forests are common and many in the Action Areas and allow for the management of timber, especially selective cutting. One area that showed timbering was east of US 231 at Doan's Creek in Greene County. At this location, less than an acre of woods was cut for black walnut. Another area included the timbering of hardwood southwest of Cincinnati in the American Bottoms. Downed trees were abundant and timbering included less than 20 acres. From such observations and discussions with county officials, timbering is not expected to be a major contributor to the loss of woodland within the Action Areas.

Many planned residential subdivisions were investigated to ascertain potential forest losses in the Action Areas. There were approximately 100 plus planned and currently expanding subdivisions still being built within the Action Areas. The bulk of these developments were located in the northern portion of the Action Area just south of Indianapolis, in non-forested areas along SR 37. In the Wabash Lowland Region (i.e., Vanderburgh, Warrick, Pike, Gibson and Daviess counties), forests were for the most part in woodlots surrounded by farm fields. In addition, many of these are forested wetlands and/or in flood prone areas. The majority of the few subdivisions recorded were developed upon previously cleared lands, not forestlands.

In the forested counties of Greene, Monroe, and Morgan, subdivisions were for the most part in developed lands too with some exceptions. The major exception was the proposed Clifty Hills and Blue Ridge Estates in Greene County. Its proposed location is northeast of Kileen with approximately 1,150 acres planned for development. The development of such property could potentially take many acres of forest. Other smaller planned subdivisions in Greene County are Lawrence Hollow Estates and Green Hills Estates South. These two subdivisions would take much less forested acres.

Monroe County and Morgan County have a number of subdivisions planned; however, many of these are near SR 37 in open lands surrounding the city of Bloomington. Examples of planned subdivisions in Monroe County are Farmers Field Acres, Rolling Glen Estates, Harrell Road Subdivision, and Orchard Estates in the vicinity of Hindustan. In Morgan County, a few examples of planned subdivisions are Turkey Knob, Country Club Woods, and The Oaks. Most of the subdivisions located within the Action Areas take marginal acres of forestland.

Most of the planned subdivisions in the Action Areas were found in open lands of the Tipton Till Plain within Marion County and Johnson County. Some example of planned subdivisions in Marion County are Willingshire Community, Bluffs Subdivision, Bayberry Village, Silver Springs Subdivision, Governor's Pointe Subdivision, Ridgehill Trail Subdivision, and Thompson Meadows Subdivision. Examples in Johnson County are Shadowood, Woods at Somerset, Smokey Row

Estates, Manor at Somerset, Persimmon Woods, and Northridge. Many of these subdivisions were located around existing subdivisions in the area and are part of the Indianapolis metropolitan area.

A review of the potential for loss of forest due to timbering and residential development in the Action Areas showed limited timbering and many planned subdivisions; however, the majority would be located on open lands with limited forestland impacts. The only exception appeared to be Clifty Hill and Blue Ridge Estates northeast of KOLEEN. Timbering and residential development could potentially remove possible roost and foraging habitat for the Indiana bat. Specific acres of forest loss will be addressed in Tier 2 studies, as needed.

We anticipate decline in bat habitat in some areas of the Summer and Winter Action Areas in the future, although we are not aware of specific development plans in known bat habitat at this time. As we become aware of specific projects, impacts to Indiana bats will be addressed through the incidental take permit process, if appropriate.

Areas set aside for mitigation plantings will protect those areas from development in the short term, and in the long term will provide quality roosting and foraging habitat. These areas will also help to decrease habitat fragmentation, and to improve the potential for colonies of Indiana bats currently using the action area to expand into other areas of suitable habitat. With successful implementation of the Tier 1 Forest and Wetland Mitigation and Enhancement Plan and all of the other proposed mitigation efforts and conservation measures, we anticipate that long-term habitat conditions for Indiana bat maternity colonies, individuals and hibernating populations within the action areas may be better than existing conditions. Additional cumulative effects (if any) will be investigated and addressed in Tier 2 studies and project-section consultations.

Cumulative Effects within the Bald Eagle Action Area

Current and reasonably foreseeable non-federal activities that may occur within the Bald Eagle Action Area are timbering, planned development for residential subdivisions, and recreational activities that occur along open waterways. Various departments and individuals were contacted for such information. They included contacting the surveyor's office, recorder's office, auditor's office, highway superintendents, county and planning officials. Because, the Bald Eagle Action Area falls completely within the Indiana Bat Summer Action Area, the cumulative effects from timbering and planned residential subdivisions are essentially the same as those mentioned above for Indiana bats. Timbering and residential development is not expected to remove optimum nesting and perching sites for bald eagles as these primarily occur in riparian buffers and flood-prone areas.

Most water-based recreation activities (e.g., boating, jet skiing, and fishing) that occur near sensitive areas used by bald eagles are concentrated at large public reservoirs, such as Lake Monroe in Monroe County. Other areas associated with bald eagles such as the East Fork White River, West Fork White River, and Patoka River are frequented by motor boats less often than Lake Monroe. The majority of the recreation activities conducted along these rivers is associated with smaller motorized boats and canoes. Repeated disturbances from recreation activities near lakes and rivers may disrupt nesting eagles and potentially cause nest abandonment. Additional cumulative effects (if any) will be investigated and addressed in Tier 2 studies and project-section consultations.

VI. CONCLUSION

After reviewing the current status of Indiana bat and bald eagle, the environmental baseline for the action areas, the aggregate effects of the proposed construction, operation, and maintenance of the interstate and associated development, and the cumulative effects, **it is the Service's biological opinion that Alternative 3C of I-69 from Evansville to Indianapolis, as proposed, is not likely to jeopardize the continued existence of either the Indiana bat or the bald eagle.** Critical habitat for the Indiana bat has been designated at two locations in Indiana, however, this action will not affect either and no destruction or adverse modification of that critical habitat is anticipated. No critical habitat has been designated for the bald eagle.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are **non-discretionary**, and must be undertaken by the FHWA or their designee (e.g., INDOT) for the exemption in section 7(o)(2) to apply. The FHWA has a continuing duty to regulate the activity covered by this incidental take statement. If the FHWA fails to assume and implement the terms and conditions of the incidental take statement, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the FHWA must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR §402.14(i)(3)].

INDIANA BAT

AMOUNT OR EXTENT OF TAKE

The Service anticipates that incidental take of Indiana bats will occur in the form of harm through habitat loss, and death by collisions with vehicles. Based on our knowledge of the ecology of Indiana bats, and the distribution of Indiana bats within the Summer and Winter Action Areas of I-69, we assume that the habitat that will be lost will adversely affect the roosting and foraging habitat of Indiana bats.

Based on our analysis of the environmental baseline and effects of the proposed action, the Service anticipates that at least one maternity colony of Indiana bats occupy the Summer Action Area and may be impacted as the result of the proposed project. The effect of the loss of foraging habitat is expected to result in the death of some bats (e.g., as the result of exposure to predation or overwinter mortality of bats that have not stored adequate fat). Loss of roosting habitat and degradation of remaining habitat may also result in harm of individual bats; while these effects are not expected to result directly in the death of bats, they may exacerbate the effect of loss of foraging habitat. Collectively, the effects of the action are expected to result in behavioral or physiological effects which impair reproduction and recruitment, or other essential behavioral patterns. Death of individuals, decreased fitness of individuals, reduced reproductive potential, and reduced overwinter survival of some unquantifiable number of individuals may result. The effects on an assumed

colony may be lost reproductive capacity and potentially a short-term decline in the size of the colony.

Construction of I-69 along the proposed 3C alignment and its associated actions is expected to result in the permanent loss of approximately 1,137 acres of suitable summer foraging and roosting habitat for Indiana bats. This estimate includes 1,062 acres of upland and bottomland forest, 65 acres of forested wetlands, 5 acres of scrub-shrub wetlands, and 5 acres of emergent wetlands. In addition, approximately 400 acres of forest and 30 acres of wetlands will be permanently lost as part of development that the Interstate is expected to induce over time. Therefore, the total loss of forest habitat would be approximately 1,527 acres and the total loss of non-forested wetlands would be approximately 40 acres with a combined total of 1,567 acres of Indiana bat habitat. Degradation of remaining habitat is also likely to occur from increased fragmentation and increased disturbance.

It is unlikely that direct mortality of bats will be detected, that is, we do not expect that dead or moribund bats will be found, even though we expect that some number of individuals within a colony may die as result of the proposed actions. In fact, there is no practical means to directly measure these impacts to bats. Therefore, the anticipated level of take is being expressed below as the permanent loss of currently suitable summer roosting and foraging habitat and fall swarming and staging habitat for Indiana bats that will result from project implementation as estimated in the Tier 1 Biological Assessment, and summarized below.

Summer Action Area:

Permanent direct and indirect loss of up to 1,527 acres of forest habitat and 40 acres of non-forested wetlands is anticipated. Approximate loss of forest (from Table 8 of the BA) within each project section includes:

- Project Section 1: 14 acres,
- Project Section 2: 123 acres,
- Project Section 3: 37 acres,
- Project Section 4: 977 acres,
- Project Section 5: 120 acres, and
- Project Section 6: 29 acres.

Winter Action Area:

Permanent loss of up to 947 acres of forest habitat surrounding 10 known hibernacula is anticipated (from Table 9 of the BA). Approximate loss of forest (from Table 9 of the BA) within a 5-mile radius of each hibernaculum includes:

- Ashcraft Cave: 438 acres,
- Sexton Springs Cave: 371 acres,
- Reeve's Cave: 364 acres,
- Leonard Springs Cave: 309 acres,
- King Blair/Brinegar Cave: 306 acres,
- Saltpeter Cave: 277 acres,
- Buckner's Cave: 270 acres,
- Coon's Cave: 112 acres,
- Grotto Cave: 88 acres, and
- Salamander Cave: 50 acres.

Note: the sum of acreages associated with individual caves equals 2,585 acres. However, this is not the total amount of forest that will be lost because some forested areas fall within 5 miles of multiple caves and therefore are repeatedly counted in the individual acreages above.

The Service anticipates that all bats that are struck by vehicles will be killed. The Service assumes that the annual number of deaths by vehicle collisions is not likely to exceed 10 Indiana bats. However, based on the best available scientific data, the actual number of Indiana bats that may be struck and killed from vehicles traveling on I-69 between Evansville and Indianapolis can not be precisely quantified during Tier 1. Therefore, this issue will be reexamined during each Tier 2 project-section consultations when more specific information will be available.

EFFECT OF THE TAKE

In the accompanying biological opinion, the Service determined that the aggregate level of anticipated take is not likely to result in jeopardy to Indiana bats or destruction or adverse modification of designated critical habitat.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary and appropriate to further minimize take of Indiana bats:

1. In the Tier 1 BA, the FHWA proposed to investigate and/or implement numerous conservation measures and mitigation efforts as part of their proposed action and these measures are hereby incorporated by reference. These measures will benefit a variety of wildlife species, including Indiana bats. The Service will take the necessary steps to ensure that the FHWA successfully implements all the conservation measures to the fullest extent practicable.
2. The implementation status of all the proposed conservation measures, mitigation efforts, and research and any related problems need to be monitored and clearly communicated to the Service on an annual basis.
3. All I-69 construction personnel and INDOT maintenance staff need to be made aware of potential issues concerning Indiana bats and construction and maintenance of I-69.
4. The FWHA needs to ensure that the impacts of take associated with future Tier 2 project-section specific actions are appropriately minimized and that the exemption of incidental take is appropriately documented and anticipated levels of incidental take will not be exceeded or that any new forms of take may occur that were not anticipated in Tier 1.

The Service believes that the measures above are necessary, appropriate, and reasonable for minimizing take of Indiana bats.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the FHWA must comply with the following terms and conditions, which implement the reasonable and prudent measures. These terms and conditions are non-discretionary.

1. The FHWA must implement all proposed mitigation and conservation measures, as detailed in the "Tier 1 Forest and Wetland Mitigation and Enhancement Plan" and "Conservation Measures for Impacts to Threatened and Endangered Species" sections and Appendix B of the Tier 1 BA or alternative measures that are of equal or greater benefit to Indiana bats as developed in consultation with the Service during Tier 2.
2. FHWA will prepare an annual report detailing all conservation measures, mitigation efforts, and monitoring that have been initiated, are ongoing, or completed during the previous calendar year and the current status of those yet to be completed. The report will be submitted to the Service's BFO by 31 January each year (the first report will be due 1/31/05) and reporting will continue until all proposed actions have been completed.

If proposed conservation measures or mitigation goals can not be realized (e.g., lack of willing-sellers), then FHWA will investigate and propose alternative solutions that can be realized and are of equal or greater benefit to Indiana bats within the Summer and Winter Action Areas.

3. All I-69 engineering supervisors, equipment operators, and other construction personnel and INDOT maintenance staff will attend a mandatory environmental awareness training that discloses where known sensitive Indiana bat sites are located in the project area, addresses any other concerns regarding Indiana bats, and presents a protocol for reporting the presence of any live, injured, or dead bats observed or found within or near the construction limits or right-of-way during construction, operation, and maintenance of I-69.
4. To ensure that the impacts of take associated with future Tier 2 project-section specific actions are appropriately minimized and that the exemption of incidental take is appropriately documented, the FHWA and the U.S. Fish and Wildlife Service will implement an appended programmatic consultation approach for I-69. Under that approach this programmatic Biological Opinion and Incidental Take Statement will exempt incidental take that result from the implementation of site-specific actions that result from implementation of the proposed action as detailed in the Tier 1 BA. However, specific impacts within each Tier 2 Project Section must be individually reviewed by the Service to determine if they are consistent with this programmatic Incidental Take Statement's reasonable and prudent measures and associated terms and conditions, and to ensure that site-specific impacts of the resulting incidental take are minimized. If effects of an individual Tier 2 Project Section are found to be consistent with those analyzed in the programmatic consultation, then it will be appended to this programmatic Biological Opinion and Incidental Take Statement, along with any additional project section-specific reasonable and prudent measures and terms and conditions that are needed to fulfill the requirements of section 7(a)(2).

Because acreages of lost Indiana bat habitat are being used to monitor levels of incidental

take within the entire Summer and Winter Action Areas as well as within each Tier 2 Project Section and 5-mile radius around each known hibernaculum, the FHWA will provide the Service's Bloomington Field Office with a detailed description of each project sections contribution to habitat loss by preparing Tier 2 Biological Assessments for each project section. The Tier 2 Biological Assessments must include: maps of the preferred final alignment and all associated development; methods and results of Tier 2 mist net surveys, radio-tracking studies, roost tree emergence counts, and hibernacula surveys; exact locations of all known and newly discovered Indiana bat roost trees and hibernacula (hibernacula location maps must delineate all of their hydrologically connected surface streams and sinkholes and their drainage basins in relation to I-69); the total acreages and relative quality (i.e., maturity of forest and estimated suitability for roosting and foraging) of forest and wetland habitats that will be permanently cleared/filled; and all other anticipated project section-specific impacts and their anticipated level of incidental take (e.g., roadkills). Tier 2 BAs must also describe any additional direct or indirect affects that were not considered during the programmatic consultation. To reduce redundancy, Tier 2 BAs should summarize or simply reference sections of the Tier 1 BA that would otherwise be repetitive.

Each Tier 2 BA must track how the individual Tier 2 Project Section increases the cumulative forest and wetland acres quantified in the AMOUNT OR EXTENT OF TAKE section above and report how much total acreages are remaining. Any known Indiana bats killed from vehicle collisions will also be tracked in this manner. Your cover letters requesting Project-Section specific reviews must include your determination that the proposed project is consistent with this programmatic Biological Opinion and Incidental Take Statement and request that the proposed Tier 2 BA be appended to this programmatic Biological Opinion. The cover letter, and one bound hard copy and an electronic copy of the Tier 2 BA should be submitted to the BFO when requesting a project section review.

5. Any dead bats located within the construction limits, right-of-way, rest stops, or mitigation areas of I-69, regardless of species, should be immediately reported to BFO [(812) 334-4261], and subsequently transported (frozen or on ice) to BFO. No attempt should be made to handle any live bat, regardless of its condition; report bats that appear to be sick or injured to BFO. BFO will make a species determination on any dead or moribund bats. If an Indiana bat is identified, BFO will contact the appropriate Service Law Enforcement office as required.

The FHWA will keep track of all known Indiana bats killed from vehicle collisions to ensure that the anticipated amount of incidental take, 10 killed per year, is not exceeded.

In conclusion, the Service believes that the permanent loss of currently suitable summer roosting and foraging habitat for Indiana bats will be limited to 1,567 acres within the Summer Action Area (SAA) and 947 acres within the Winter Action Area (WAA). These acreages represent approximately a 1% loss of the SAA's forested acreage and less than a 1% loss of the WAA's forested acreage and will occur over a period of at least several years. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded (or clearing occurs during the period April 15-September 15 in the SAA or April 1-November 15 within the WAA any given year) such incidental

take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The FHWA must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

BALD EAGLE

AMOUNT OR EXTENT OF TAKE

The Service anticipates that incidental take of bald eagles will occur in the form of death or injury resulting from collisions with vehicles once I-69 is operational. Based on the best available scientific data, the actual number of eagles that may be struck and killed/injured from vehicles traveling on I-69 between Evansville and Indianapolis can not be precisely quantified. The Service anticipates that collisions with eagles would most likely occur during the winter when food is more scarce and eagles are more apt to scavenge on carrion from roadkilled animals. Once I-69 is operational, we anticipate that all eagles that are struck by vehicles will be killed or injured and that the number of deaths and/or injuries would not exceed 3 bald eagles during any five-year period. Because bald eagles are large birds and would be widely recognized by most motorists and maintenance workers, we anticipate most roadkilled or injured eagles would eventually be reported to the Service, and therefore, the actual level of incidental take could be fairly accurately monitored over time.

The amount of forested habitat that will be permanently cleared for construction of bridges at the two major river crossings (E. Fork of White River and Patoka River, where bald eagles are most likely to occur) was not quantified in the Tier1 BA. However, from our review of aerial photos and maps of the project area, we anticipate that the total combined amount of forest that will be lost at these two river crossing will be equal to or less than 50 acres and that an ample amount of habitat will remain available to bald eagles in these areas. Furthermore, the potential for incidental take from loss of future eagle habitat will be minimized by the proposed forest and wetland mitigation efforts. Therefore, we believe that if forest loss at these sites is equal to or less than 50 acres, then the impact will be insignificant in size and not likely to adversely affect nesting or wintering eagles.

EFFECT OF THE TAKE

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to bald eagles. No critical habitat has been designated for bald eagles, so none would be impacted.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary and appropriate to further minimize take of bald eagles:

1. In the Tier1 BA, the FHWA proposed to investigate and/or implement numerous conservation measures and mitigation efforts as part of their proposed action and these

measures are hereby incorporated by reference. These measures will benefit a variety of wildlife species, including bald eagles. The Service will take the necessary steps to ensure that the FHWA successfully implements all the conservation measures to the fullest extent practicable.

2. The implementation status of all the proposed conservation measures, mitigation efforts, and research and any related problems need to be monitored and clearly communicated to the Service on an annual basis.
3. All I-69 construction workers and INDOT maintenance staff need to be made aware of potential issues concerning bald eagles and construction and maintenance of I-69.
4. The FHWA needs to ensure that the impacts of take associated with future Tier 2 project-section specific actions are appropriately minimized and that the exemption of incidental take is appropriately documented and anticipated levels of incidental take will not be exceeded or that any new forms of take may occur that were not anticipated in Tier 1.

The Service believes that the measures above are necessary, appropriate, and reasonable for minimizing take of bald eagles.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the FHWA must comply with the following terms and conditions, which implement the reasonable and prudent measures. These terms and conditions are non-discretionary.

1. The FHWA must implement all proposed mitigation and conservation measures, as detailed in the "Tier 1 Forest and Wetland Mitigation and Enhancement Plan" and "Conservation Measures for Impacts to Threatened and Endangered Species" sections and Appendix B of the Tier 1 BA or alternative measures that are of equal or greater benefit to bald eagles as developed in consultation with the Service during Tier 2.
2. The FHWA will prepare an annual report detailing all conservation measures, mitigation efforts, and monitoring that have been initiated, are ongoing, or completed during the previous calendar year and the current status of those yet to be completed. The report will be submitted to the Service's BFO by 31 January each year (the first report will be due 1/31/05) and reporting will continue until all proposed actions have been completed.

If proposed conservation measures or mitigation goals can not be realized (e.g., lack of willing-sellers), then FHWA will investigate and propose alternative solutions that can be realized and are of equal or greater benefit to bald eagles within the Bald Eagle Action Area.

3. All I-69 engineering supervisors, equipment operators, and construction workers and INDOT maintenance staff will attend a mandatory environmental awareness training that discloses where known bald eagle nests are located in the project area, addresses any other concerns regarding bald eagles, and presents a protocol for reporting any eagle nests, and any live, sick, injured, or dead eagles observed or found within or near the construction limits or right-of-way during construction, operation, and maintenance of I-69. Project

personnel will also be instructed about the terms and conditions of the ITS and the restrictions imposed by them before construction and operation begins.

4. To ensure that the impacts of take associated with future Tier 2 project-section specific action are appropriately minimized and that the exemption of incidental take is appropriately documented, the FHWA and the U.S. Fish and Wildlife Service will implement an appended programmatic consultation approach for I-69. Under that approach this programmatic Biological Opinion and Incidental Take Statement will exempt incidental take that result from the implementation of site-specific actions that result from implementation of the proposed action as detailed in the Tier 1 BA. However, specific impacts within each Tier 2 Project Section must be individually reviewed by the Service to determine if they are consistent with this programmatic Incidental Take Statement's reasonable and prudent measures and associated terms and conditions, and to ensure that site-specific impacts of the resulting incidental take are minimized. If effects of an individual Tier 2 Project Section are found to be consistent with those analyzed in the programmatic consultation, then it will be appended to this programmatic Biological Opinion and Incidental Take Statement, along with any additional project section-specific reasonable and prudent measures and terms and conditions that are needed to fulfill the requirements of section 7(a)(2).

Because acreages of lost bald eagle habitat are being used to insure that habitat loss in eagle use areas (Patoka River and E. Fork White River crossings) does not reach the scale where take will occur, the FHWA will provide the Service's Bloomington Field Office with a detailed description of each project sections contribution to habitat loss by preparing Tier 2 Biological Assessments for each project section. The Tier 2 Biological Assessments must include: maps of the preferred final alignment and all associated development; methods and results of Tier 2 bald eagle surveys, exact locations of all known and newly discovered eagle nests, night roosts, and other important areas; the total acreages and relative quality (i.e., maturity of forest and estimated suitability for nesting, perching, roosting) of forest and wetland habitats that will be permanently cleared/filled; and all other anticipated project section-specific impacts and their anticipated level of incidental take (e.g., roadkills). Tier 2 BAs must also describe any additional direct or indirect affects that were not considered during the programmatic consultation. To reduce redundancy, Tier 2 BAs should summarize or simply reference sections of the Tier 1 BA that would otherwise be repetitive.

Each Tier 2 BA must track how the individual Tier 2 Project Section increases the forest acres quantified in the AMOUNT OR EXTENT OF TAKE section above and report how much total acreage is remaining. Your cover letters requesting Project-Section specific reviews must include your determination that the proposed project is consistent with this programmatic Biological Opinion and Incidental Take Statement and request that the proposed Tier 2 BA be appended to this programmatic Biological Opinion. The cover letter, and one bound hard copy and an electronic copy of the Tier 2 BA should be submitted to the BFO when requesting a project section review.

5. Any dead bald or golden eagles found within the construction limits, right-of-way, rest stops, or mitigation areas of I-69, should be reported to BFO [(812) 334-4261] as soon as possible and subsequently transported (frozen or on ice) to BFO.

Any sick or injured bald or golden eagle located within the construction limits, right-of-way, rest stops, or mitigation areas of I-69 should immediately be reported to BFO (and an Indiana Conservation Officer or the State Police if outside of normal business hours or on weekends). If possible, attempts should be made to remove an injured eagle from harms way, until a trained person arrives to safely capture and transport the bird. Sick and injured eagles will be transported to a veterinarian or a rehabilitation center that has a valid Federal permit to treat and rehabilitate eagles.

BFO will contact the appropriate Service Law Enforcement office to report that a sick, injured, or dead eagle has been found.

The FHWA will keep track of all known bald eagles killed or injured from vehicle collisions to ensure that the anticipated amount of incidental take, 3 killed/injured bald eagles during any five-year period, is not exceeded.

The Service will not refer the incidental take of any migratory bird or bald eagle for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. §§ 703-712), or the Bald and Golden Eagle Protection Act of 1940, as amended (16 U.S.C. §§ 668-668d), if such take is in compliance with the terms and conditions specified herein.

In conclusion, the Service anticipates that the number of deaths and/or injuries from vehicle collisions would not exceed 3 bald eagles during any five-year period. If this level of take or less occurs, we expect that the effects to Indiana breeding and wintering bald eagle populations will be negligible. We anticipate that if 50 or less acres of forested habitat that will be permanently cleared for construction of bridges at the two major river crossings, East Fork of the White River and the Patoka River, where bald eagles are most likely to occur, then the impact will be insignificant in size and not likely to adversely affect nesting or wintering bald eagles. Impacts to eagle habitat will also be minimized by the proposed conservation measures and forest and wetland mitigation efforts. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The FHWA must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action/program on listed species or critical habitat, to help implement recovery plans, or to develop information. Conservation recommendations generally do not focus on a specific project, but rather on an agency's overall program.

The Service provides the following conservation recommendations for the FHWA's consideration; these activities may be conducted at the discretion of FHWA as time and funding allow:

INDIANA BAT

1. Working with the Service, develop guidelines for addressing Indiana bat issues associated with FHWA projects in the Midwest.
2. Expand on scientific research and educational outreach efforts on Indiana bats in coordination with the Service's BFO.
3. In coordination with the BFO, purchase or otherwise protect additional Indiana bat hibernacula in Indiana.
4. Provide funding to staff a full-time Indiana bat Recovery Coordinator position within the BFO, which has the Service's national lead for this wide-ranging species.

BALD EAGLE

1. Working with the Service, develop guidelines for addressing Bald Eagle issues associated with FHWA projects in the Midwest.
2. If delisted, provide funding to implement a bald eagle post-delisting monitoring plan in Indiana or throughout the Midwest.
3. Expand on educational and outreach efforts on bald eagles in Indiana.

In order for the Service to be kept informed of actions for minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION NOTICE

This concludes formal programmatic consultation with FHWA on the construction, operation, and maintenance of the I-69 from Evansville to Indianapolis, Indiana and associated development. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that the may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action (e.g., highway construction and associated development) are subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

LITERATURE CITED

- 3D/International Inc. 1995. Environmental technical report: 1995 field studies for interim Indiana bat habitat mitigation at the Indianapolis International Airport in Marion County, Indiana. 23 pp. plus appendices.
- 3D/International, Inc. 1998. Mist net survey and telemetry study of Indiana bats (*Myotis sodalis*) on the Tell City Ranger District of the Hoosier National Forest in Crawford and Perry Counties, Indiana. 38 pp. plus appendices.
- American Geological Institute. 2001. Living With Karst: A Fragile Foundation. AGI Environmental Awareness Series 4. 64 pp.
- Bernardin-Lochmueller & Associates. 2003. Tier 1 biological assessment for threatened and endangered species, interstate 69, Indianapolis to Evansville [dated July 18, 2003, revised October 27, 2003; submitted to the Bloomington Field Office of the U.S. Fish and Wildlife Service by the Federal Highway Administration and Department of Transportation
- Brack, V., Jr. 1983. The nonhibernating ecology of bats in Indiana with emphasis on the endangered Indiana bat, *Myotis sodalis*. Ph.D. dissertation, Purdue Univ., West Lafayette, Ind. 280pp.
- BHE Environmental, Inc. (BHE). 1999. Mist net and radiotelemetry surveys for the Indiana bat at the Crane Division, Naval Surface Warfare Center, Indiana. Unpublished technical report. Cincinnati, Ohio. 39 pp.
- Brack, V. Jr, and R. K. LaVal. 1985. Food habits of the Indiana bat in Missouri. *Journal of Mammalogy* 66(2):308-315.
- Brack, V. Jr, and K. Tyrell. 1990. A model of the habitat used by the Indiana bat (*Myotis sodalis*) during the summer in Indiana: 1990 field studies. Indiana Department of Natural Resources, Division of Fish and Wildlife, Endangered Species Program, Project E-1-4, Study No. 8. 42pp.
- Brack, V., T. Larkins, and S. Bell. 1987. The bats of Crane Naval Weapons Support Center, Indiana. Report to Indiana Department of Natural Resources, Indianapolis.
- Brack, V., Jr, S. A. Johnson, and R. K. Dunlap. 2003. Wintering populations of bats in Indiana, with emphasis on the endangered Indiana Myotis, *Myotis sodalis*. *Proceedings of the Indiana Academy of Sciences* 112:61-74.
- Callahan, E.V., III. 1993. Indiana bat summer habitat requirements. M.S. Thesis. University of Missouri, Columbia. 84 pp.
- Callahan, E.V., R.D. Drobney, and R.L. Clawson. 1997. Selection of summer roosting sites by Indiana bats (*Myotis sodalis*) in Missouri. *J. Mammalogy*: 78(3):813-825.

- Castrale, J. 2003. Personal communication. Indiana Department of Natural Resources Non-game Bird Biologist.
- Castrale, J. and A. Holbrook. 2003. Indiana Department of Natural Resources Wildlife Management Notes. Indiana Department of Natural Resources, Mitchell, Indiana.
- Clark, D.R., Jr., R.K. LaVal, and D.M. Swineford. 1978. Dieldrin-induced mortality in an endangered species, the gray bat (*Myotis grisescens*). *Science* 199:1357-1359.
- Clawson, R.L. 2002. Trends in population size and current status in A. Kurta and J. Kennedy eds. *The Indiana Bat: Biology and Management of an Endangered Species*. Bat Conservation International, Austin, Texas.
- Cope, J. B., A. R. Richter, and R. S. Mills. 1977. Spring and Autumn Swarming Behavior in the Indiana Bat, *Myotis sodalis*. *Journal of Mammology* 58(1):93-95.
- Dunlap, K. 2001. Population Trends of Indiana Bats in Indiana. Indiana Karst Conservancy Update 63:14-19.
- Franson, J.C., Sileo, L., and N.J. Thomas. 1995. Causes of eagle deaths. In E.T. LaRoe, G.S. Farris, C.E. Puckett, P.D. Doran and M.J. Mac eds. *Our Living Resources*. U.S. Department of Interior, National Biology Service, Washington, D.C.
- Gardner, J.E., J.D. Garner, and J.E. Hofmann. 1991a. Summary of *Myotis sodalis* summer habitat studies in Illinois: with recommendations for impact assessment. Unpublished report prepared for the Indiana/Gray Bat Recovery Team Meeting, Columbia, Mo. Illinois Natural History Survey, Section of Faunistic Surveys and Insect Identification. 28pp.
- Gardner, J.E., J.D. Garner, and J.E. Hofmann. 1991b. Summer roost selection and roosting behavior of *Myotis sodalis* (Indiana bat) in Illinois. Unpublished report, Illinois Natural History Survey, Section of Faunistic Surveys and Insect Identification. 51pp.
- Garner, J. D., and J. E. Gardner. 1992. Determination of summer distribution and habitat utilization of the Indiana bat (*Myotis sodalis*) in Illinois. Final Report. Project E-3. Illinois Department of Conservation, Division of Natural Heritage and Illinois Natural History Survey, Center for Biogeographic Information. 25 pp.
- Gray, H. 2000. Physiographic Divisions of Indiana. Indiana University, Indiana.
- Gumbert, M.W., J.M. O'Keefe, and J.R. MacGregor. 2002. Roost site fidelity. In A. Kurta and J. Kennedy eds. *The Indiana Bat: Biology and Management of an Endangered Species*. Bat Conservation International, Austin, Texas.
- Hofmann, J. 1996. Indiana Bats in Illinois. INHS Reports, March-April 1996. Illinois Natural History Survey. Available: <http://www.inhs.uiuc.edu/chf/pub/surveyreports/mar-apr96/bats.html> (Accessed: February 5, 2003)

- Homoya, M. A., Abrell, B. D., and J. R. Aldrich. 1985. The Natural Regions of Indiana. D.R. Winslow ed. Proceedings of the Indiana Academy of Science 94:245-268.
- Hoosier National Forest (HNF). 2000. Programmatic Biological Assessment: Land and Resource Management Plan. Unpublished Report. Hoosier National Forest, Bedford, Indiana. 109 pp + Appendix.
- Humphrey, S. R., A. R. Richter, and J. B. Cope. 1977. Summer Habitat and Ecology of the Endangered Indiana Bat, *Myotis sodalis*. Journal of Mammology 58(3):334-346.
- Humphrey, S. R., and J. B. Cope. 1977. Survival rates of the endangered Indiana bat, *Myotis sodalis*. Journal of Mammology 58:32-36.
- Kiser, J.D., J.R. MacGregor, H.D. Bryan, and A. Howard. 2002. Use of concrete bridges as nightroosts. in A. Kurta and J. Kennedy eds. The Indiana Bat: Biology and Management of an Endangered Species. Bat Conservation International, Austin, Texas.
- Kurta, A., D. King, J.A. Teramino, J.M. Stribley, and K.J. Williams. 1993. Summer Roosts of the Endangered Indiana Bat (*Myotis sodalis*) on the Northern Edge of its Range. American Midland Naturalist 129(1): 132-138.
- Kurta, A., S. W. Murray, and D. H. Miller. 2002. Roost Selection and Movements Across the Summer Landscape in A. Kurta and J. Kennedy eds. The Indiana Bat: Biology and Management of an Endangered Species. Bat Conservation International, Austin, Texas.
- Lehman, R.N. 2001. Raptor electrocution on power lines: current issues and outlook. Wildlife Society Bulletin 29: 84-813.
- Montgomery Watson. 1997. Final survey of bat species: Atterbury Reserve Forces Training Area, Edinburg, Indiana. Report prepared for the Military Dept. of Indiana: Contract #DAHA90-94-0013.
- Montgomery Watson. 1999. Final Indiana bat (*Myotis sodalis*) mist netting and telemetry study for Camp Atterbury, Indiana. Report prepared for Military Department of Indiana (Contract No. DAHA90-94-D-0013, Delivery Order No. 538). 19pp. plus tables and appendices.
- Mumford, R. E., and J. O. Whitaker, Jr. 1982. Mammals of Indiana. Indiana University Press, Bloomington, Indiana. 537 pp.
- National Speleological Society (NSS). 2003. Cave Life: Hey, What Lives Down There Anyway? Available: <http://www.caves.org/grotto/mig/learn3.html> (Accessed: June 17, 2003).
- NatureServe Explorer. 2002. Version 1.6. Arlington, Virginia, USA: NatureServe. Available: <http://www.natureserve.org/explorer> (Accessed: January 27, 2003)
- Pruitt, L. 1995. Summary of Jefferson Proving Ground bat surveys: 1993-1995. U.S. Fish and Wildlife Service, Bloomington Field Office, Unpublished report. 5pp.

- Rommé, R.C., K. Tyrell, and V. Brack, Jr. 1995. Literature summary and habitat suitability index model: components of summer habitat for the Indiana bat, *Myotis sodalis*. Report to Indiana Department of Natural Resources, Federal Aid Project E-1-7, Study No. 8. 38pp.
- Rommé, R. C., A. B. Henry, R. A. King, T. Glueck, and K. Tyrell. 2002. Home range near hibernacula in spring and autumn. in A. Kurta and J. Kennedy eds. *The Indiana Bat: Biology and Management of an Endangered Species*. Bat Conservation International, Austin, Texas.
- Russell, A. L., C. Butchkoski, A. Tibbels, and G. F. McCracken. 2002. Bats, Road-Kill, and the FBI (Flat Bat Investigation). *Bat Research News* 43 (4): 180.
- Sealander J. A., and G. A. Heidt. 1990. *Arkansas Mammals*. The University of Arkansas Press, Fayetteville, Arkansas. 308pp.
- U.S. Fish and Wildlife Service (USFWS). 1983a. Northern States Bald Eagle Recovery Plan. Bethesda, Maryland. 124 pp.
- U.S. Fish and Wildlife Service (USFWS). 1983b. Recovery plan for the Indiana bat. Washington, D.C. 80pp.
- U.S. Fish and Wildlife Service (USFWS). 1999. Agency Draft Indiana Bat (*Myotis sodalis*) Revised Recovery Plan. Fort Snelling, Minnesota. 53pp
- U.S. Fish and Wildlife Service (USFWS). 2002. Biological Opinion on the Application for an Incidental Take Permit for the Federally Endangered Indiana Bat (*Myotis sodalis*) for the Six Points Road Interchange and Associated Development. Unpublished Report. Bloomington Field Office, Bloomington, Indiana. 35 pp.
- Whitaker, J.O., Jr. 1994. Survey of bats and search for endangered bat species, particularly the Federally endangered Indiana bat (*Myotis sodalis*) and the State endangered evening bat (*Nycticeius humeralis*), in the area of the proposed Zenas Lake project along the Muscatatuck River in Jennings County, Indiana. Report to Algonquin Consultants, Inc. 20 pp.
- Whitaker, J. O., Jr. 1996. Survey of Summer Bat Communities and Search for Endangered Bat Species at 21 Sites Along the Proposed Bloomington to Evansville Highway Route in Gibson, Pike, Daviess, Greene, and Monroe Counties in Southwest Indiana Highway Corridor - Draft EIS Appendices. Indiana Department of Transportation, Indianapolis, Indiana.
- Whitaker, J.O., Jr., and V. Brack Jr. 2002. Distribution and summer ecology in Indiana. in A. Kurta and J. Kennedy eds. *The Indiana Bat: Biology and Management of an Endangered Species*. Bat Conservation International, Austin, Texas.